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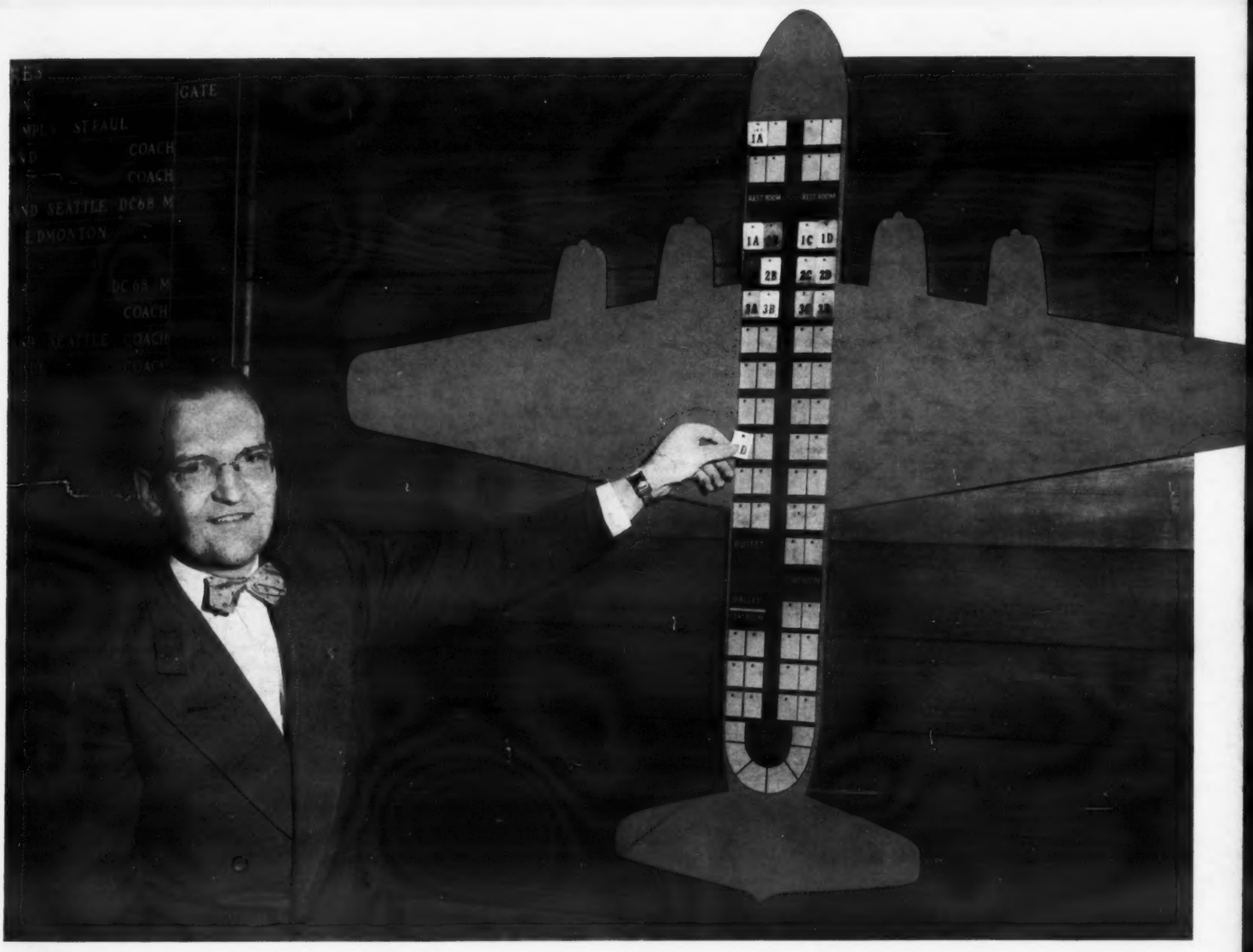

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IN THIS ISSUE

Debit and Credit in Air Transport

VOLUME X 4 1955

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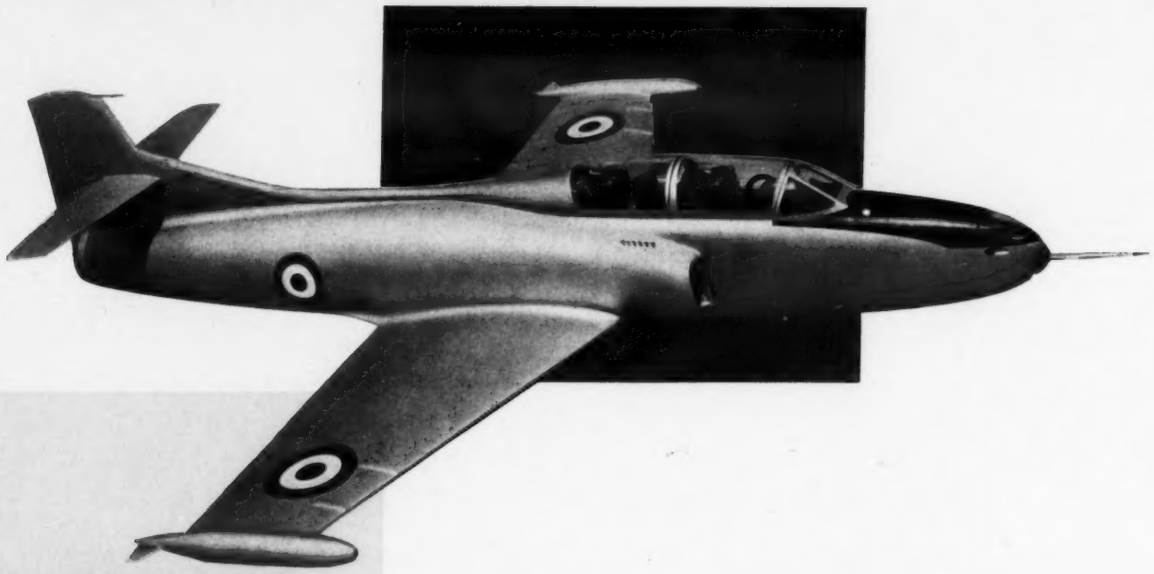

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Volume X — No. 4 — 1955

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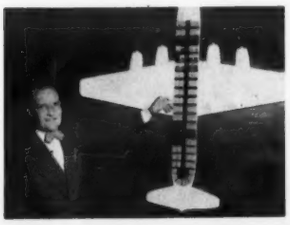
Contents

DEBIT AND CREDIT IN AIR TRANSPORT 235
Is Talk of an Air Transport Crisis Justified ? M. HYMANS, PARIS 238
Air Transport Can Avoid a Crisis R. S. DAMON, KANSAS CITY 240
A Bright Decade Ahead — If . . .
Mass Transportation by Air Lies in Aircoach Expansion E. V. RICKENBACKER, NEW YORK 242
The Air Hostess Told Us . . . 243
"Crisis" is Too Strong a Word C. GOMEZ LUCIA, MADRID 244
Commercial Aviation in the Forefront of Progress E. DELCLAUX, PARIS 246
Air Transport Diagnoses its Ills and Prepares for Tomorrow P. M. GALLOIS, PARIS 247
The Engines for Tomorrow's Airliners 252
Back to Luxury 255
Some Reflections on the Comet Inquiry J. H. STEVENS, LONDON 257
"CONAD" 260
End of a Honeymoon ? 261
Let's Land On! 262
Progress in Pictures 264
What's in the Air? 265
The Next Generations of Long Range Aircraft SIR ARNOLD HALL, FARNBOROUGH 267
After the German Ratification 269
Equipment Round-Up 270



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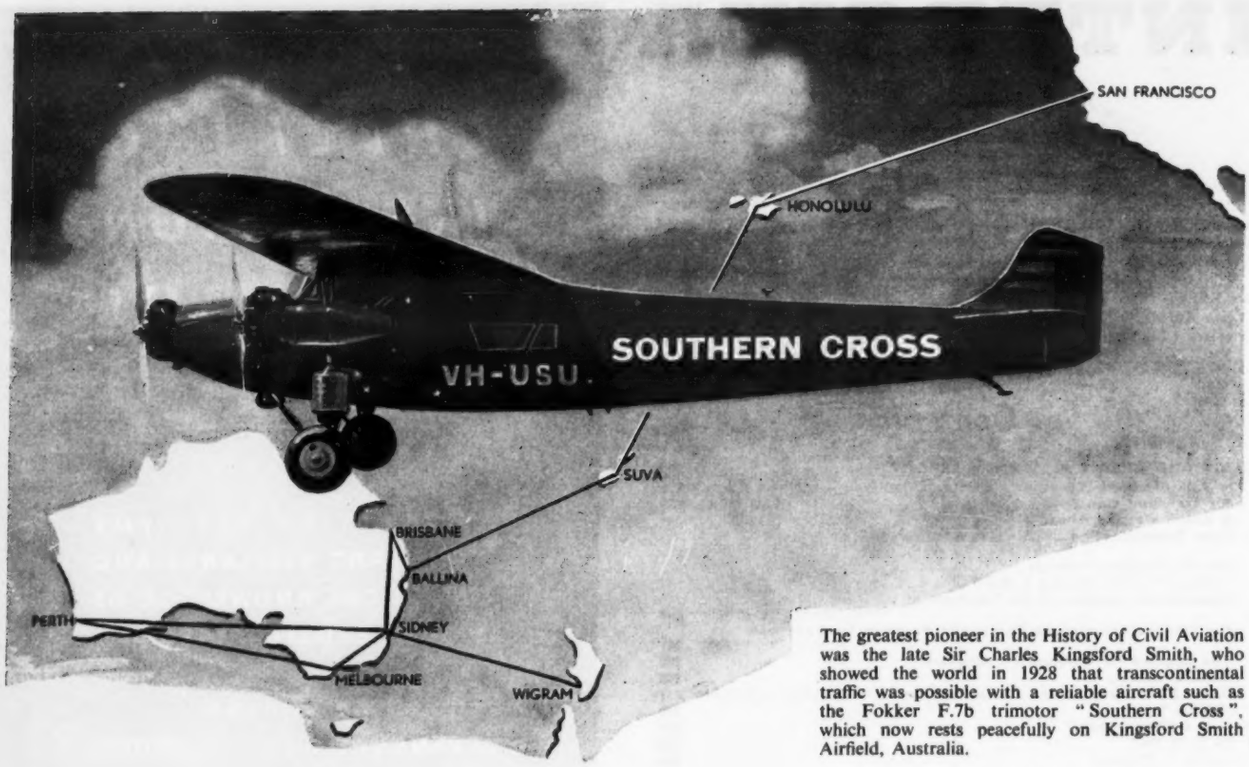

The greatest pioneer in the History of Civil Aviation was the late Sir Charles Kingsford Smith, who showed the world in 1928 that transcontinental traffic was possible with a reliable aircraft such as the Fokker F.7b trimotor "Southern Cross", which now rests peacefully on Kingsford Smith Airfield, Australia.

PIONEERS IN THE PAST — Fokker — PIONEERS IN THE FUTURE

FOKKER WILL SPAN THE WORLD AGAIN!

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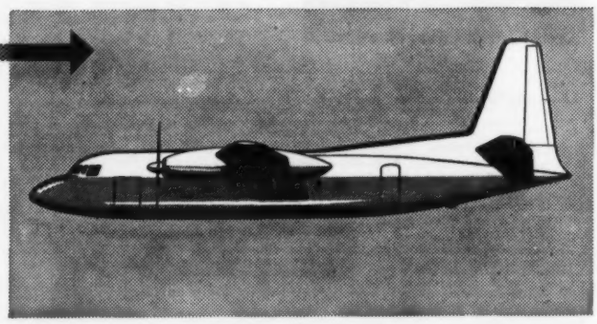

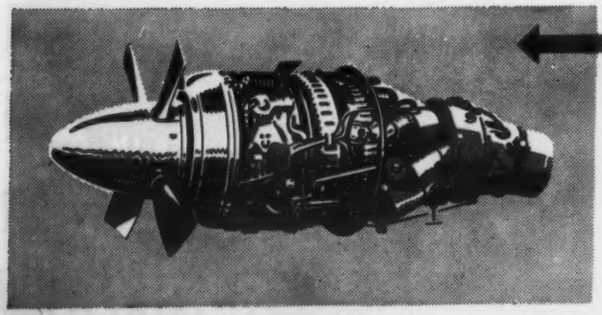

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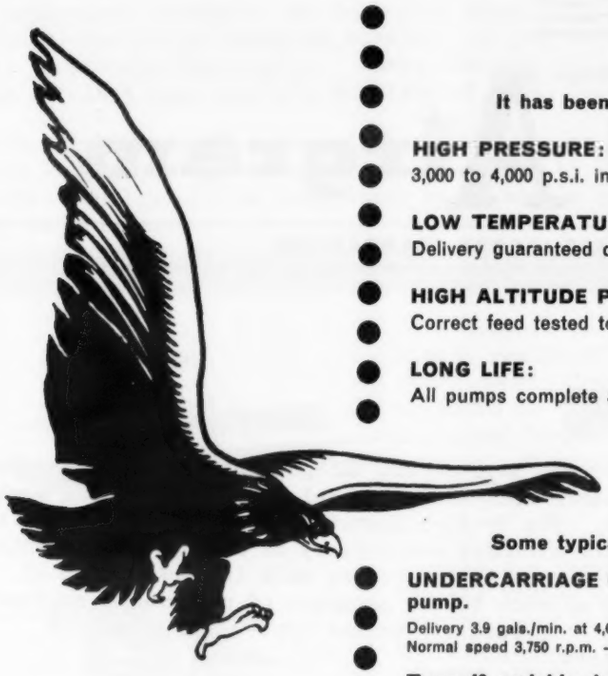

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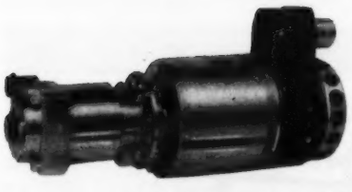

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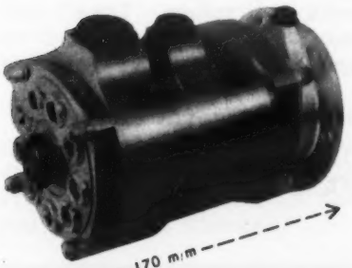

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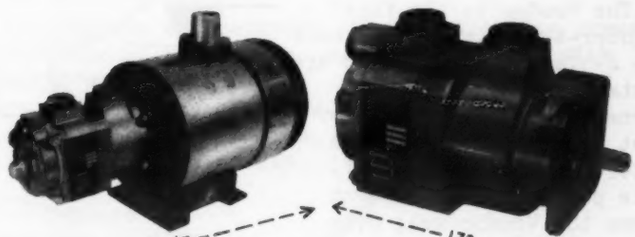

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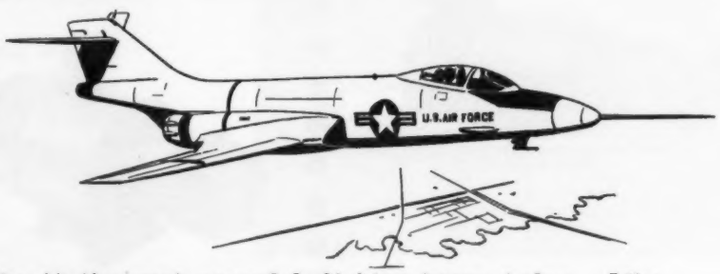
BRITISH ENGINEERS HONOR IGOR SIKORSKY

Aeronautical pioneer Igor I. Sikorsky, Engineering Manager of Sikorsky Aircraft, has been named to receive the 1955 James Watt International Medal, one of the world's top honors in mechanical engineering. The British Institution of Mechanical Engineers makes the award every two years on the birthday anniversary of James Watt, inventor of the steam engine. The citation declares the award was made in recognition of Mr. Sikorsky's life work in applying science to the progress of mechanical engineering, through his pioneering development of aircraft of various types, multi-engined amphibians and particularly helicopters.

MOST POWERFUL FIGHTER-BOMBER UNVEILED BY U. S. AIR FORCE

America's most powerful fighter-bomber, the McDonnell F-101 Voodoo, has been unveiled by the U. S. Air Force. The Voodoo was designed to meet Air Force needs for a long-range fighter. It is being produced in St. Louis, Missouri, and is scheduled to be assigned to the Strategic Air Command within the Air Force. The big fighter is the third new Air Force jet fighter model to be powered by Pratt & Whitney Aircraft's J-57 turbojet engine.



The Voodoo is the first fighter-type aircraft to have two J-57s. These engines are fitted with special afterburners which are about two feet shorter than standard afterburners for the J-57. This power plant equipment gives the Voodoo well over 20,000 pounds of thrust, to make it the most powerful fighter known today. Like other supersonic Air Force and Navy aircraft built around the J-57 engine, the McDonnell F-101 is designed to take full advantage of the outstanding fuel economy and tremendous thrust of its twin J-57s.

Wing span is 39 feet. Length is 67 feet. The F-101 is in the supersonic speed class, and is able to carry atomic weapons. The big aircraft is now being test flown at the Edwards Flight Test Center in California.

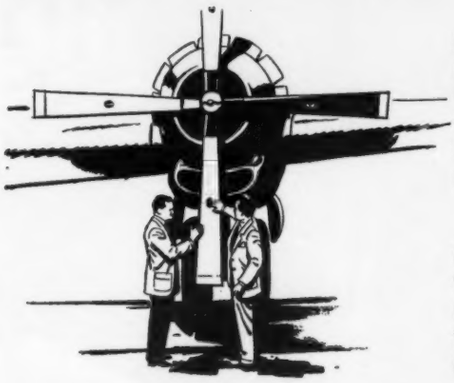
Other new jet fighters powered by Pratt & Whitney Aircraft's 10,000-pound thrust class J-57 turbojets are the North American F-100 Super Sabre and the Convair F-102 interceptor, both Air Force planes, and the Navy's Douglas F4D Skyray carrier-based interceptor-fighter.

[redacted] STANDARD PNEUMATIC STARTERS FOR [redacted]

Lightweight pneumatic jet engine starters, designed and built by Hamilton Standard, are being furnished to the U. S. Air Force for installation on McDonnell F-101 Voodoo fighter-bombers. These starters deliver over 100 horsepower and yet weigh far less than electric starters of equal power.

Hamilton Standard's pneumatic starter harnesses a jet stream of compressed air with a 7-inch turbine wheel which spins up to 45,000 revolutions per minute. It operates equally well on compressor bleed air as high as 700°F, or on air from an external source.

PROPELLER LIFE EXTENDED BY NEW HAMILTON STANDARD PROCESS



A process to make hollow steel propeller blades highly resistant to damage by loose stones or other debris drawn into the propeller disk during takeoffs or other ground operations, has been announced by Hamilton Standard. The development involves an armor coating of nickel over a zinc and copper base.

The nickel-plated blades already have been adopted for service by two major airlines and the air forces of three countries. Test and service records show that blades protected by the new process have a greater service life, greater safety, and require less maintenance.

Hamilton Standard first disclosed its work with the special armor coating about two years ago. Prior to flight testing, blades treated by the process were put through hundreds of hours of grueling punishment. Plated and unplated blades, revolving at takeoff speeds, were bombarded with small stones. They were even targets for glass missiles fired from shotguns. These tests, plus nearly 750,000 hours of subsequent flight service testing, proved the effectiveness of the new nickel plating process.

NEW FLOAT-TYPE LANDING GEAR EXTENDS WORK OF S-55 HELICOPTERS

Use of commercial Sikorsky S-55 helicopters to transport oil well drilling crews to and from their jobs offshore in the Gulf of Mexico, is now being expanded with the development of new flotation landing gear for the S-55. The gear is approved by the Civil Aeronautics Administration, an agency of the U. S. government. It permits the big S-55s to land safely on water or marshland, as well as on their regular heliports, on barges, tenders or platforms at sea.

The flotation gear is available to replace the four fixed landing wheels usually installed on S-55s. Weight of this installation is about the same as that of standard wheels and struts.

Sikorsky Aircraft pioneered with flotation gear on helicopters as early as 1940. The world's first helicopter landings and takeoffs from water were made in the historic VS-300 equipped with floats.

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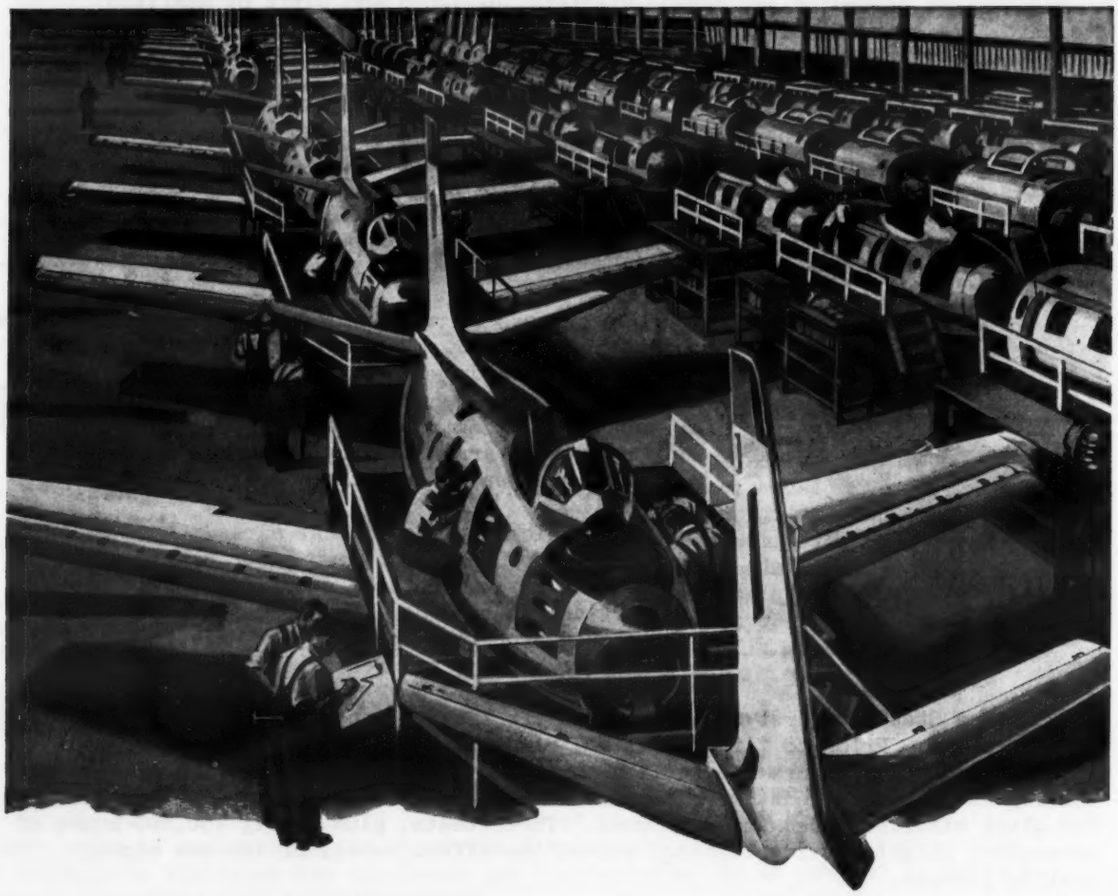
A Single Goal...



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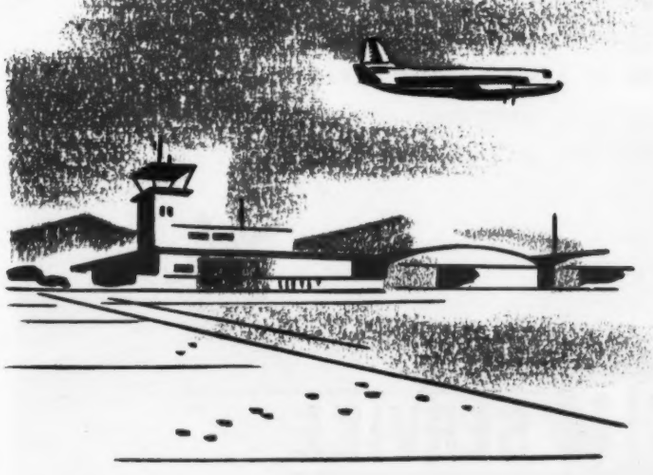

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Other airlines which have purchased Collins Radio Equipment for their Viscounts are Air France, Aer Lingus, British West Indian Airways, Fred. Olsens Flyselskap, Linea Aeropostal Venezolana, Misrair, Trans-Australia Airlines and Trans-Canada Air Lines.

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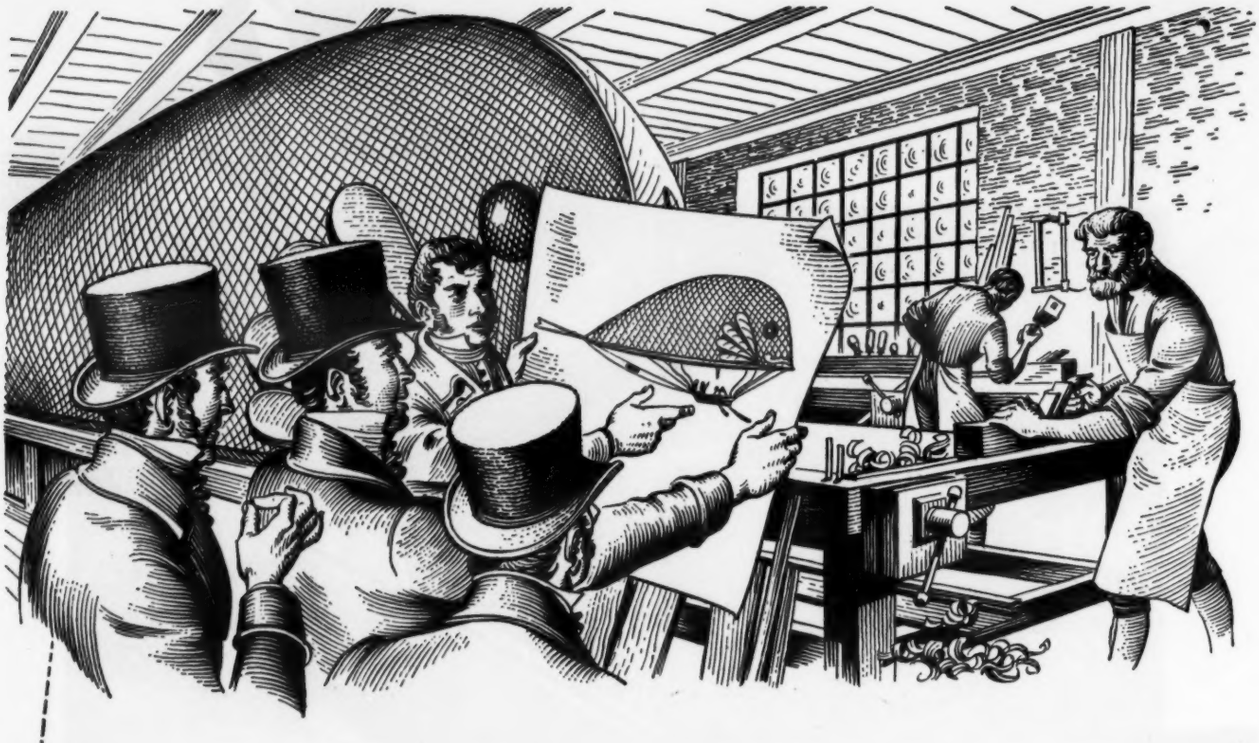

The Flying "Whale"

LONDON, 1816.

OUR aeronautical correspondent yesterday inspected a strange dirigible which is at present being constructed by S. T. Pauly and Durs Egg, Swiss gunsmiths. The airship is to be propelled by oars and fins, powered by a kind of atmospheric steam engine invented by Mr. Collier. To give control in climb and descent, a hinged horizontal fin with an adjustable ballast weight is fitted.

"Free Ballooning," said Mr. Pauly, "is a pleasant enough pastime. But my aim is to produce a controllable aircraft which is fast and efficient; an aircraft as renowned for these qualities"—and here he paused as if lost for a word—"as is the BP Aviation Service. The public may not yet understand that comparison, but they will, gentlemen, they will!"

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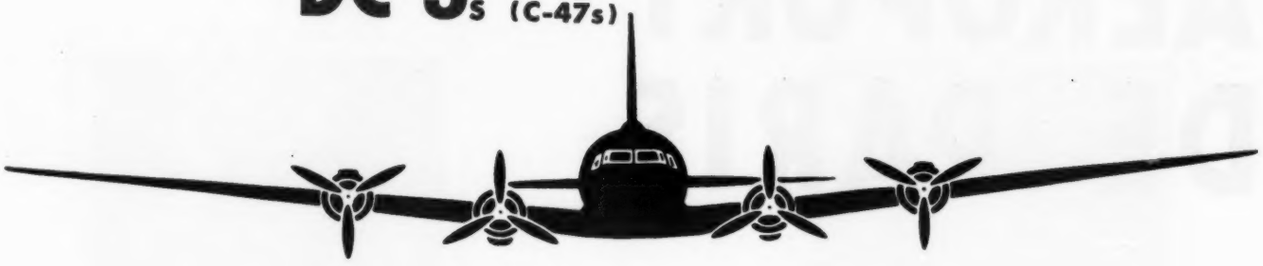
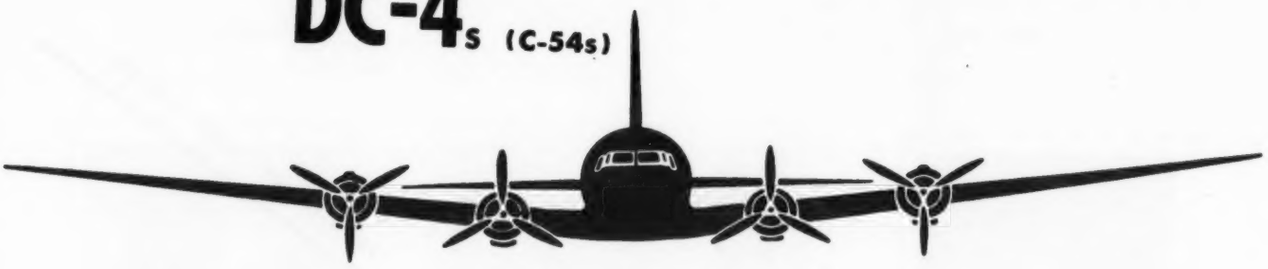


DC-4s (C-54s)



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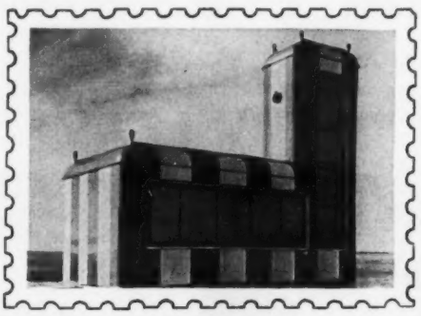

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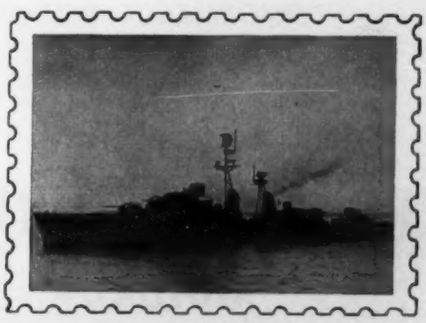

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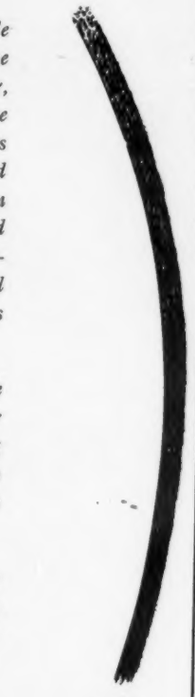
The 1955 Canadian International Trade Fair will be of particular interest to all those concerned with the aircraft industry. This year, the Aviation Section will be bigger and more comprehensive than before, featuring exhibits from Great Britain, the U.S.A., Canada, and Czechoslovakia. The latest developments in aircraft and components can be examined and discussed with the manufacturers' representatives—who will also be able to supply full information on prices, deliveries, quantities and terms.

Organized in conjunction with the Trade Fair, the famous Canadian International Air Show takes place on June 4th, thus enabling visitors to combine close-up examination with actual demonstration of some of the world's most interesting aircraft.

The Aviation Section and the Air Show are two reasons why this year's Canadian International Trade Fair is a "must" for air-minded people the world over.

For further information, write to your nearest Canadian Government Trade Office or direct to: The Administrator, Canadian International Trade Fair, Exhibition Park, Toronto, Ontario, Canada.



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Paris	14 ½	hrs.	Brussels	15	hrs.	Madrid	13	hrs.
Frankfurt	16	hrs.	Amsterdam	15 ½	hrs.	Copenhagen	16	hrs.
			Zurich	15 ½	hrs.	Stockholm	17	hrs.
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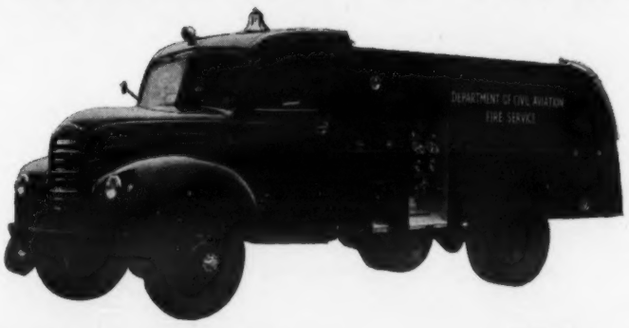

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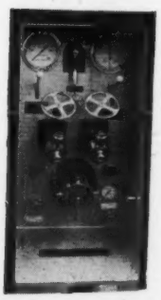
ONE OF THE DUAL CONTROL PANELS



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For the pilot it is the most "docile" of aircraft, for the passenger the most comfortable. No more noise on board, no vibration, a maximum of air volume, a maximum of visibility. Fully sound-proofed and pressurized, the cabin is 40 ft. long and nearly 10 ft. wide, with big windows giving passengers a wide view outside.

Air France "Viscounts" operate services every day to:
London, Hamburg, Stockholm, Geneva.
Every weekday to Rome.
Four times a week to Copenhagen.
Three times a week to Vienna, Munich, Milan.
All these services, except the special "Epicurien" service to London, are tourist class.

Air France serves 35 cities in Europe. Its network is the longest in the world, with 230 points of call in 72 countries and five continents.

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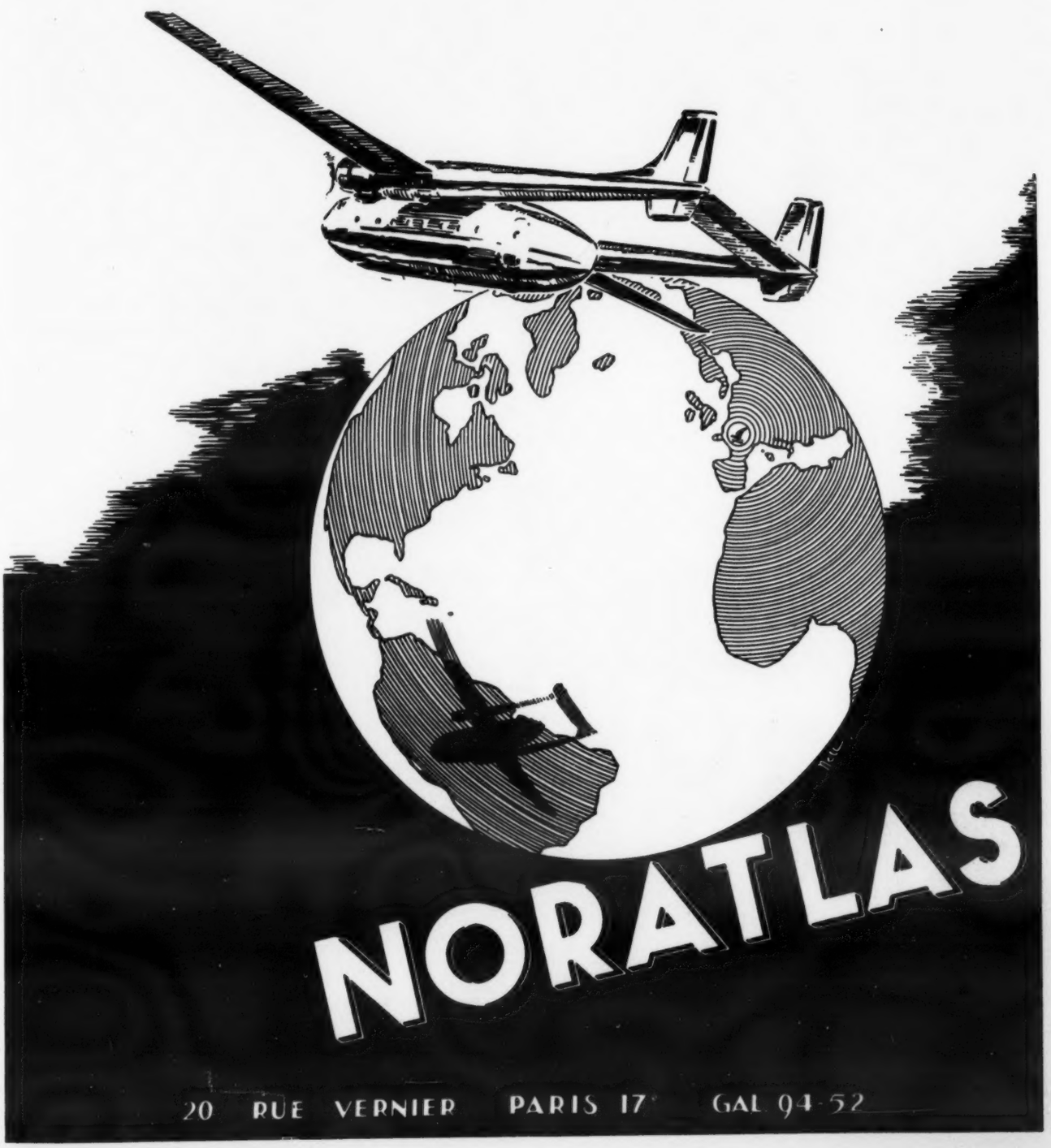

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Policemen, Firemen, Foremen, Airfield Supervisors and many other key men are more effective when in constant radio contact with their headquarters. The Pye Walkiephone, which weighs only 10½ lb., is ideal for this purpose.

An outstanding tribute to the Walkiephone was paid by Sir John Hunt, who praised the part it played in the victorious assault on Everest.

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Pye Radio & Television (Pty.) Ltd Johannesburg South Africa	Pye Limited Mexico City	Pye Limited Tucuman 829 Buenos Aires	Pye Corporation of America 5th Avenue Building 200, 5th Avenue, New York

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INTERAVIA

Deadline Notes

No. 4, 1955

U.S.A.F. RETALIATION IN THE EVENT OF ATTACK

Under a new plan drawn up by the U.S. Defense Department and top Service officials, Strategic Air Command will be able to make immediate retaliation in "an emergency" without previous authorization from the President, if the President should be prevented from taking the decision. Hitherto only the President - as Commander-in-Chief of the Armed Forces - has had power to sign such an order. Who may now sign the authority, however, is still a military secret.

AMERICA HAS 26 GUIDED MISSILE PROJECTS

According to the Aircraft Industries Association's Annual Report for 1954, there are 26 new types of guided missiles in the project stage in the United States. The importance attributed to the weapons can be gathered from the fact that the Department of Defense is spending as much on research and development in this field as in that of piloted aircraft.

FALCON MISSILE FOR U.S.A.F. ARCTIC UNITS

The U.S. Air Force announces that the Hughes Falcon air-to-air rocket with target-seeking head, now in production, will shortly be delivered to all-weather interceptor units stationed in the Arctic and at other approaches to the North American Continent. Released photographs show it to be roughly 6 ft. 6 ins. long. Once the target is spotted on the interceptor's radar scope, an electronic computer takes over and fires the missile automatically. Its built-in electronic guidance system enables it to follow all the target's manouevres and finally destroy it.

FIRST ARTIFICIAL SATELLITE IN SIGHT

If all goes well the world's first artificial satellite may be launched within two years, according to present Pentagon estimates. It will however be much smaller than hitherto envisaged, carrying highly miniaturized telemetering equipment. Washington experts now estimate that overall costs will be as low as $20,000,000 - and not $1,000,000,000 as recently cited by General Joseph T. McNarney of Convair.

N.A.T.O. AIR BASE IN TURKEY

Following international competitive tenders, contracts for the construction of the N.A.T.O. Air Base at Murted, Turkey have been awarded to three French firms, Chantiers Modernes, Fougerolles, Boussiron. The work, total cost of which is estimated at francs 5,000,000,000 (roughly $12,000,000) is to be completed by the end of 1956.

U.S. TITANIUM METALLURGICAL LABORATORY

A Defense Department contract with the Battelle Memorial Institute, Colombus, Ohio, provides for the establishment of a titanium metallurgical laboratory to advise manufacturers on the use of titanium in arms production.

RECORD ENTRIES FOR PARIS AIRCRAFT SHOW

The number of participants listed for the 21st Paris Aircraft Show - at which eight countries will be represented in addition to the French aircraft industry - has already surpassed all previous records. The Show will be opened by the French President at Le Bourget Airport on June 10th. June 12th will be Commercial Aviation Day, June 15th will be reserved for Sporting and Private Aviation (including a big rally), June 18th is reserved for Flight Demonstrations to official and technical delegations and trade press representatives, and June 19th will be the final day.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

HELICOPTER DEMONSTRATIONS NEAR STUTTGART

The German Helicopter Study Group is organizing a series of comparative helicopter demonstrations in the Stuttgart area from June 23rd to 25th. The following manufacturers have been invited to participate: France: S.N.C.A. du Sud-Ouest, S.N.C.A. du Sud-Est; Britain: Bristol, Westland, Saunders-Roe; United States: Bell, Hiller, Piasecki, Sikorsky.

DC-7Cs AND COMET MARK 4s FOR B.O.A.C.

British Overseas Airways Corp. has opened negotiations, with official authorization, with Douglas Aircraft Co. for the supply of ten Douglas DC-7Cs. - The Corporation has also ordered 20 Comet Mark 4s (Avon engines) for delivery in 1958. The order for Comet Mark 4s would seem to indicate that the contract for 12 Mark 2s and five Mark 3s, placed before the Elba accident, has been superseded.

SWISS ATLANTIC STATION PARTICIPATION

The Swiss Federal Council has approved Switzerland's participation in the maintenance costs of North Atlantic Weather Stations set up under the I.C.A.O. agreement. Like other countries which do not maintain their own weather ships, Switzerland will pay in proportion to the number of Swissair Atlantic crossings made each year.

EUGENE PEPIN APPOINTED TO McGILL UNIVERSITY

Doctor Eugène Pépin, well-known French air law expert who recently completed a term of office as Director of I.C.A.O.'s Legal Bureau, is to take over as Director of McGill University's Institute of International Air Law, Montreal, next autumn. He succeeds Doctor John Cobb Cooper, a well-known American lecturer on international air law and author of the basic text book "The Right to Fly".

*

Workshop Briefs...

Two hitherto undisclosed British engine firms are engaged on preliminary work on atomic power plant for aircraft, as a purely private venture. * The Transcendental model 1-G convertible aircraft is undergoing flight tests under a military development contract. Altitudes of roughly 3,200 ft. and forward speeds of over 100 m.p.h. have been attained. The aircraft is an experimental single seater with two tilting rotors fitted at the wing tips, and powered by a 160 h.p. Lycoming GO-290 engine. * A Bristol Britannia four-engined turboprop commercial transport arrived in Johannesburg on March 13th for tropical trials (take-off and landing at high altitude airports). The Britannia covered the 6,070 mile distance between London and Johannesburg in a total of 18 hrs. 52 mins., or nearly 3 hrs. less than the scheduled journey time of the Comet 1 on the same route. * A leader cable system designed to guide aircraft on the ground even in the worst visibility, is being tested by the Royal Aircraft Establishment. The cable, which runs along the ground, transmits magnetic signals to the aircraft, giving the pilot the correct heading for taxying in the form of left-right indications. * A Martin Baker ejection seat, weighing only 66 lbs. and used in conjunction with an Irving triple parachute, enables pilots to leave an aircraft safely even at ground level; the seat is ejected to a sufficient height to enable the special parachute to open. * Following the accident to a North American F-100 Super Sabre, which broke up on October 12th, 1954 during a supersonic dive at approx. 23,000 ft., all aircraft of this type (including those already delivered) are to be modified as follows: (1) the area of the rudder unit to be increased by 27%; (2) wing span to be increased by 2 ft.; (3) the "feel" of power controls to be improved. Measure (1) counters the recognized immediate cause of the break-up, in which exceptionally powerful yaw during a dive led to overload of the structure; measure (2) is designed to reduce the tendency to Dutch roll, and measure (3) will reduce the danger of over-control by the pilot.

* * *

Is Talk of an Air Transport Crisis Justified?

First of all, what is a crisis? Never mind the academic definition; for the present purpose just take the picturesque American version: boom? wine, women and song . . . crisis: beer, Momma and the radio.

Air passengers are still being treated to champagne on board, so there is not much question of "beer" yet, and hence not of crisis. Read first what President Terrell C. Drinkwater of Western Air Lines has to say in this issue on his company's champagne services. Incidentally, during the 1947–49 air transport crisis this same Mr. Drinkwater said: "We think the public today is more interested in savings in fares than they are in 'free' food. It will be good to get out of the restaurant business and be able to concentrate our energies on safe, efficient, dependable transportation."

This is by the way, to show how situations change and yet are constantly repeated.

*

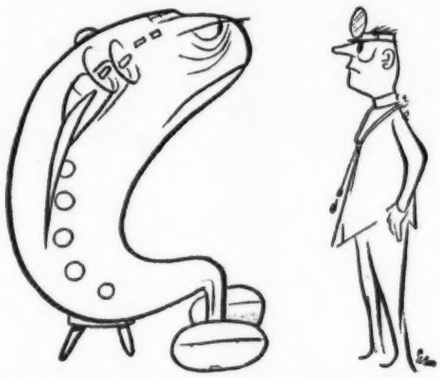
Now to the point!

It was in September 1954 that Sir William P. Hildred, Director-General of the International Air Transport Association, sounded the first alarm at the Paris Meeting of I. A. T. A.

"While the amount of travel and shipment on the airlines has increased, reductions in cargo rates and the fact that more and more passengers fly on the cheaper, tourist services have retarded a corresponding increase in the airlines' revenues during 1954. In spite of 1954's record performance and 1955's promise of further traffic expansion, the industry's optimism must therefore be flavoured with a large dash of caution. The profit margins of airline operation—out of which we must pay shareholders, service debts and put aside reserves for the future—are little more than one per cent on a global basis."

*

Is it possible to foretell the future of air transport? At best the latest developments can be studied to see whether optimism or pessimism is more justified. Remembering that air transport passed through a real crisis in 1947 to 1949—of which more will be said later—the following table illustrating the position on January 1st, 1954, is informative.



What indications of the susceptibility of air transport are provided in this I.C.A.O. table?

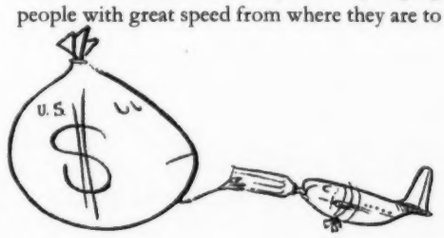
At best the following statistical conclusions: though the number of passengers carried has increased from year to year, the rate of increase slowed down to 12% and 13% in the crisis years of 1947–49 and actually sank to 11% in 1954, after reaching 28% during the Korean War. But what the table does not show is the fact that larger and faster aircraft have meanwhile been introduced on all international routes.

The I.C.A.O. figures do not give any definite sign of a new air transport crisis, though they do indicate that a certain amount of caution is called for.

*

What was the nature of the 1947–49 air transport crisis, which was felt particularly in American domestic operations? The subject was discussed with wit and humour by the economist D. Bernstein in "Harper's Magazine" (April 1949?) under the title "Our Air-sick Airlines". Certain passages and some of the accompanying drawings by Robert Osborne are reproduced here, to refresh the reader's memory:

"Of all industries in our 'free enterprise' system, the airline is the most modern, the showiest, and—at this moment—the most spectacularly a commercial failure. On a map of our sprawling country, the routes of the Big Sixteen—the certificated trunk lines—criss and cross like arteries and capillaries pumping people with great speed from where they are to



where they want to go . . . Surely these domestic passenger lines should be doing well in our era of heavy profits. They are not. With one startling exception, they are all in financial trouble, or would be except for bountiful gifts from the public treasury . . . Only Captain Eddie Rickenbacker's Eastern showed the sensational, and on the whole unsubsidized, profit of $1,683,000 in the first eight months of 1948 alone . . . Obviously, a passenger airline can be successful only if its planes are well filled by paying customers. During the war, nearly every seat was filled on every flight. Today two out of every five seats are empty . . . If Adam Smith were to have his way, this could only mean that most of the Big Sixteen should go out of business . . . But Adam Smith had no inkling of our American system of subsidized enterprise. The fact is that, since the

Development of World Air Transport

Scheduled international and domestic routes

(International Civil Aviation Organization figures)

Year	km. flown millions	Passengers carried millions	Increase over previous year	Freight tonne-km. millions	Mail tonne-km. millions	Mean passenger number	Increase over previous year	Average distance flown per passenger (km)	Increase over previous year
1954	1,940	57.8	+ 11%	1,045	317	26.5	+ 7%	891	+ 1%
1953	1,860	52.0	+ 16%	1,016	274	24.7	+ 6%	887	+ 1%
1952	1,705	45.0	+ 13%	975	256	23.2	+ 6%	880	+ 2%
1951	1,570	39.9	+ 28%	905	234	21.9	+ 15%	863	− 1%
1950	1,432	31.2	+ 18%	757	209	19.1	+ 10%	875	− 1%
1949	1,345	26.5	+ 13%	569	187	17.3	+ 5%	879	− 1%
1948	1,270	23.5	+ 12%	417	166	16.5	− 1%	889	− 1%
1947	1,140	21.0	+ 15%	273	128	16.6	+ 1%	900	+ 6%
1946	940	18.2	+ 96%	120	98	16.5	+ 20%	852	− 3%
1945	600	9.3	.	113	132	13.7	.	882	.

Medium-Range Commercial Aircraft

Types in service				
USA:	Convair Liner 340	2 Pratt & Whitney R-2800 CB. 16	(2,400 h.p. each)	44 to 56 passengers
	Martin 4-0-4	2 Pratt & Whitney R-2800 CB. 16	(2,400 h.p. each)	40 to 44 passengers
GB:	Vickers *Viscount Series 700*	4 Rolls-Royce *Dart 505*	(1,550e.h.p. each)	40 to 59 passengers
	Vickers *Viscount 700D*	4 Rolls-Royce *Dart 510*	(1,700e.h.p. each)	40 to 59 passengers
	Airspeed *Ambassador*	2 Bristol *Centaurus 661*	(2,625 h.p. each)	40 to 49 passengers
	Bristol *Freighter 32*	2 Bristol *Hercules 734*	(1,980 h.p. each)	32 to 44 passengers
FRN:	Nord 2501 *Noratlas*	2 SNECMA / Bristol *Hercules 758*	(2,040 h.p. each)	40 passengers
	SNCASO SO. 30P *Bretagne*	2 Pratt & Whitney R-2800 CA. 18	(2,400 h.p. each)	30 to 43 passengers
	Hurel-Dubois HD. 32	2 Pratt & Whitney R-1830-92 or Wright R-1820-9HE	(1,200 h.p. or 1,480 h.p. each)	34 to 44 passengers
SWED:	Saab-90 A-2 *Scandia*	2 Pratt & Whitney R-2180E.1	(1,800 h.p. each)	24/32 to 40 passengers
SPAIN:	CASA 201 *Alcotán*	2 Armstrong Siddeley *Cheetah 27* or ENMASA *Sirio VII*	(400 h.p. or 500 h.p. each)	10 passengers
USSR:	Ilyushin IL-12	2 Shvetsov ASh-82 FNV	(1,750 h.p. each)	27 to 32 passengers
Projects and Prototypes				
USA:	Convair 340 development	Turboprops (4 *Dart* ?)	—	at least 50 passengers
	Lockheed	Turboprops (T-56, *Dart* or *Eland*)	—	at least 50 passengers
	Douglas DC-6 development for medium stages	Turboprops (Allison T-56)	—	—
	Fairchild M-186	2 turbojets (Wright J-67?)	(approx. 11,000 lbs. each)	40 to 64 passengers
	Vickers *Viscount Series 800*	4 Rolls-Royce *Dart 510*	(1,700 e.h.p. each)	up to 70 passengers
	Vickers *Viscount* replacement (Type 870?)	Turboprops	(4,000 h.p.-class)	up to 100 passengers
	Aviation Traders *Accountant*	2 Rolls-Royce *Dart RDa. 6*	(approx. 1,700 e.h.p. each)	32 to 36 passengers
	Handley Page (Reading) HPR. 3	4 Alvis *Leonides Major*	(870 h.p. each)	36 to 44 passengers
	English Electric	1 Armstrong Siddeley *Double Mamba*	—	up to 32 passengers
	Hunting Percival P. 87	Turboprops (*Eland*?)	—	36 passengers
FRN:	SNCASE SE. 210 *Caravelle*	2 R.-R./Hispano *Avon*	(10,000 lbs. each)	70 passengers
	Hurel-Dubois HD. 45	2 R.-R./Hispano *Avon*	(9,000/10,000 lbs. each)	up to 84 passengers
	Hurel-Dubois HD. 70	2 Rolls-Royce *Dart RDa. 6*	(approx. 1,700 e.h.p. each)	28 to 48 passengers
	SNCA du Nord 2600	2 R.-R. *Dart 506* + 2 Turboméca *Palas*	—	40 passengers
NED:	Fokker F-27 *Friendship*	2 Rolls-Royce *Dart*	(1,700 e.h.p. each)	up to 36 passengers
ITL:	Agusta-Zappata AZ-1	2 Bristol *Proteus 705*	—	up to 50 passengers
	Piaggio P. 145	2 Armstrong Siddeley *Double Mamba*	—	up to 48 passengers
	SIAI-Marchetti SM. 132	2 Rolls-Royce *Avon RA. 3-501*	(7,200 lbs. each)	up to 24 passengers
SPAIN:	CASA 207 *Azor*	2 Bristol *Hercules 730*	(2,040 h.p. each)	33 to 40 passengers
	CASA 208	2 Bristol *Hercules 738*	(2,040 h.p. each)	40 to 53 passengers

birth of the commercial airline industry, not one single major trunk line has gone bankrupt, much less gone out of business . . .

" . . . A whole industry is failing, rather than any of its parts. And the reason is that the Civil Aeronautics Board, the Congress, the airlines themselves, and most citizens who give the matter any thought have accepted the four great myths of commercial aviation:

1. That people would rather fly than anything.
2. That there is not much difference between wartime and peacetime.
3. That our airlines—separately and collectively—are sacrosanct because the national defense, American commerce, and our postal system depend on them.
4. That a subsidized, regulated industry can behave as though it were a free, competitive enterprise . . ."

"In 1938, then (when there was no U.S. Air Force; Editors), it was no doubt true that our airlines, with their planes and personnel and knowhow, were vital to the nation's defense. But times have changed. Today we have a powerful peacetime air force, with a reservoir of trained manpower, and we are not likely to reduce this force as far as the eye can see ahead. The Big Sixteen, on the other hand, own no more than a thousand planes altogether, many of them semi-obsolete . . . They could massage away the accumulated shabbiness of easy-going, over-extended management, and reduce their operating costs . . . They could charge for meals, as the railroads do; consolidate their ticket offices, etc . . . Perhaps, then, free enterprise is the one final salvation for the airlines. It would be interesting to see them experiment with this revolutionary approach."

*

What may have been true in 1947–49 no longer holds good today, except perhaps to a very modest extent. The "myths" of those days have now become facts.

Everybody—or nearly everybody—would like to fly today if he could afford it and if the time-tables suited him;

Air transport is no more susceptible to crises than any other form of transport or at any rate any other expensive means of transport;

With its expanded and modernized fleet, air transport has now become a real war reserve, a pillar of the general economy and of the mail services;

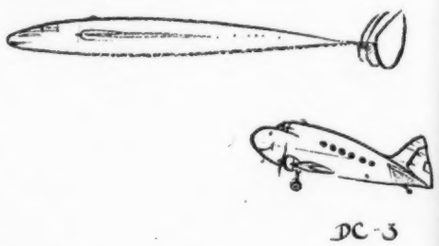
Subsidies must be accepted as necessary evils . . . What shipping lines or railways can operate without government assistance? In any case, air transport has now become a taxpayer.

*

If, as shown above, the situation is better today, how can such an expert as Sir William Hildred warn of a forthcoming crisis? Moreover he is not alone in his warnings. There are other crown witnesses.

For example, Dr. Lambertus H. Slotemaker, Executive Vice-President of K.L.M., expressed his anxiety to an Italian audience (Centro per lo Sviluppo dei Trasporti Aerei) on November 25th, 1954 as follows:

" . . . I share Sir William's views in many respects. Sir William is justified in speaking of an 'economic shockwave', caused by the shrinking profit margin between revenues and expenditure . . . International restrictions (the question of "freedoms"; Editors) have a much more unfavourable effect than fair and reasonable competition between individual airlines . . . It should not be forgotten that only 2.5% of the total population so far use the aircraft . . . Results in European air transport have been on a falling curve in recent years . . . Load factor, too, has steadily fallen, at any rate in Europe, from 66.9% in 1951 to 64.9% in 1953 and to



barely 60% in 1954 . . . In my view, national protectionism of an industry with a world-wide field of activity is illogical . . ."

A few weeks later, in February 1955, Sir George Cribbett, Deputy Secretary (Civil Aviation) at the British Ministry of Transport and Civil Aviation, spoke to the same organization;

". . . Although the hundred or more international agreements in European air transport are a somewhat heterogeneous collection, they are a godsend, as without them it would be a case of 'jungle law'.

"The Air Research Bureau set up in Brussels by six European airlines had prepared a number of facts and figures for the (unsuccessful) Strasbourg Conference on the Coordination of European Air Transport:

1. The share of European air transport in total European transport is only 15%, though it rises to 35% on the Paris–London route;
2. The share of European air transport in world air transport is only 11%;
3. The ratio of European air traffic volume (for 300 million population) to American domestic air traffic volume (for 160 million population) is in the order of 1:5."

And the head of British civil aviation cannot escape the facts that European passenger rates are 60% higher than American fares and that the European's average income is considerably lower than his American colleague's.

*

The present article contains a survey of the medium and long-range aircraft in service today throughout the world. It is completed later in the issue by an article on the engines already available or under development for air transport.—These surveys show that airlines throughout the world use the same equipment. Technically speaking therefore—at any rate in theory—all airlines should fare about equally well or equally badly.

Yet in practice they all fare very differently. By and large it can be said that American air transport works much more economically than European, that air transport in the New World has far greater possibilities and fewer worries than its brother in Europe.

If therefore there can be any question at all of critical trends in air transport, the United States form an exception. For example, U.S. airlines enjoy many freedoms in overseas traffic which are denied to their European competitors on the American continent. P.A.A. or T.W.A. make commercial landings in Paris, Geneva, Rome, Frankfurt, London, Athens etc. etc. But if ever a European airline ventures to push its nose beyond the American coast, to fly, for example, between New York and Mexico City, then the U.S. companies band together with the demand to the C.A.B.: throw him out! This is a historical fact.

The Americans are the inventors of the tourist class. For them the idea has been a success and has paid off. As American and non-American airlines sit together in the International Air Transport Association and have jointly made a great many rate agreements, the Europeans were also obliged to introduce tourist services, although they had a good idea what they were letting themselves in for... With the present fares in Europe and the income level on this continent the middle class cannot even afford tourist class travel. In Europe it is the first-class passengers who have welcomed the saving offered by the tourist class.

Rate agreements may well be a necessary evil, but it should not be overlooked that—at least up to the present—all threats of rate warfare have come not from Europe but from overseas. There is no need to mention names... What is more, the agreements have not prevented a lusty rate war from breaking out in South America, the signs of another from appearing in the Far East and yet another from threatening—barring error—in North Atlantic air freight traffic.

From time to time it is necessary to clear the air . . . This makes for better flying conditions.

*

It would also appear to be time to dispose of a number of myths that circulate from time to time in Europe. Making air transport self-supporting is a worthy object to strive for. But whether such an object can be achieved in a business that serves the general interest and whose equipment and personnel form a reserve for the event of war is doubtful. It is not known whether the U.S. Government did not provide assistance for the building of the luxury liner "United States", or what subsidies the American railroads receive. But it is known, for example, that the French railways had to be nationalized even before the war, as they could not run without subsidies, and that the Swiss Federal Railways have passed through some serious crises. Can they justifiably be held responsible for this state of affairs? They work in the interests of the community.

To return to air transport, European airlines work under much less favourable economic conditions than the Americans, although—as already stated—they use the same equipment and are no less skilled in flying.

American air transport is State controlled, just like its European counterpart, but is also organized in its Air Transport Association of America. It represents an economic power.

Where is the European association, where is the power of European air transport? If U.S. airlines should threaten a rate war there would be grounds for anxiety throughout the world. If a European airline should do the same, the Americans would merely smile.

Some years ago the timid suggestion was made here that European air transport should join together—on the model of the A.T.A.—and form a *European Air Transport Association.* Sir William Hildred described the idea at the time as "stinking". With all due respect and sympathy for Sir William, it is difficult to see what is so repulsive in the suggestion.

The inadequately prepared Strasbourg Conference failed. Being firm believers in European air transport and as Europeans we say: Long live Strasbourg! *EEH*

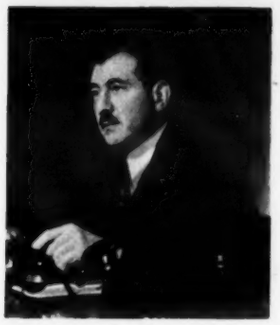
Vignettes: Robert Osborne, Salisbury, Conn.

Long-Range Commercial Aircraft

Types in service				
USA:	Douglas DC-6	4 Pratt & Whitney R-2800 CA. 15	(2,400 h.p. each)	44 to 58 passengers
	Douglas DC-6A *Liftmaster*	4 Pratt & Whitney R-2800 CB. 17	(2,500 h.p. each)	freight
	Douglas DC-6B	4 Pratt & Whitney R-2800 CB. 16/CB. 17	(2,400 / 2,500 h.p. each)	up to 90 passengers
	Douglas DC-6C	4 Pratt & Whitney R-2800 CB-Series	—	Pass./freight; up to 76 passengers
	Douglas DC-7	4 Wright R-3350 *Turbo-Cyclone 18*	(3,250 h.p. each)	60 to 95 passengers
	Douglas DC-7B	4 Wright R-3350 *Turbo-Cyclone 18*	(3,250 h.p. each)	up to 95 passengers
	Douglas DC-7C *Seven Seas*	4 Wright R-3350 *Turbo-Cyclone 18*	(3,400 h.p. each)	62 to 95 (?) passengers
	Lockheed L-749A *Constellation*	4 Wright R-3350 *Cyclone 18*	(2,500 h.p. each)	44 to 64 passengers
	Lockheed L-1049 C/D *Super Constellation*	4 Wright R-3350 *Turbo-Cyclone 18*	(3,250 h.p. each)	47 to 109 passengers
	Lockheed L-1049 E/G *Super Constellation*	4 Wright R-3350 *Turbo Cyclone 18*	(3,250 h.p. each)	63 to 99 passengers
	Boeing 377 *Stratocruiser*	4 Pratt & Whitney R-4360 B.6 / CB.2	(3,500 h.p. each)	60 to 100 passengers
CAN:	*Canadair Four / Argonaut*	4 Rolls-Royce *Merlin 626*	(1,760 h.p. each)	40 to 55 passengers
GB:	Bristol *Britannia 100*	4 Bristol *Proteus 705*	(3,780 e.h.p. each)	60 to 93 passengers
	Handley Page *Hermes 4*	4 Bristol *Hercules 763*	(2,100 h.p. each)	40 to 74 passengers
FRN:	Bréguet 763 *Deux Ponts*	4 Pratt & Whitney R-2800 CA. 18	(2,400 h.p. each)	36 to 59 passengers
	SNCASE SE. 2010 *Armagnac*	4 Pratt & Whitney R-4360 B. 13	(3,500 h.p. each)	84 to 107 passengers
Projects and Prototypes				
USA:	Douglas DC-7D	Turboprop (RB. 109, BE-25, *Eland*?)	—	—
	Douglas DC-8	4 Pratt & Whitney J-57 (?)	(10,000 lbs. each)	up to 100 passengers
	Lockheed L-1249B *Super Constellation*	4 Pratt & Whitney PT-2	(approx. 6,000 e.h.p. each)	63 to 99 passengers
	Lockheed L-1449 *Super Constellation*	4 Pratt & Whitney PT-2	(approx. 6,000 e.h.p. each)	70 + passengers
	Lockheed L-1549 (?)	4 Pratt & Whitney PT-2	(approx. 6,000 e.h.p. each)	60 to 90 passengers
	Lockheed jet airliner	Turbojets	—	100 passengers
	Boeing (707) *Stratoliner*	4 Pratt & Whitney JT3L	(10,000 lbs. each)	80 to 130 passengers
GB:	Avro *Atlantic*	4 Bristol *Olympus*	(10,000 + lbs. each)	76 to 131 passengers
	Bristol *Britannia 250/250 L.R*	4 Bristol *Proteus 755*	(4,150 e.h.p. each)	up to 87 passengers
	Bristol *Britannia 300/300 L.R*	4 Bristol *Proteus 755*	(4,150 e.h.p. each)	up to 100 passengers
	De Havilland *Comet 2*	4 Rolls-Royce *Avon 503*	(7,000 lbs. each)	44 passengers
	De Havilland *Comet 3*	4 Rolls-Royce *Avon RA. 16*	(9,000 lbs. each)	58 to 76 passengers
	Handley Page H.P. 97	4 Armstrong Siddeley *Sapphire*	(8,000 lbs. each)	up to 150 passengers
	Saunders-Roe SR/45 *Princess*	10 Bristol *Proteus 705*	(3,780 e.h.p. each)	up to 200 passengers
	Vickers VC. 7	4 Rolls-Royce *Conway*	(15,000 lbs. each)	100 to 150 passengers

Air Transport CAN Avoid a Crisis

BY MAX HYMANS, PRESIDENT, AIR FRANCE



Max Hymans, President of Air France and I.A.T.A. President for 1954—55.

Is talk about a crisis in commercial aviation justified today? Terms such as this, which can be taken in several different connotations, should be used with care, as otherwise it would be easy to paint a false picture of the situation and draw false conclusions regarding the action needed. I shall therefore begin by indicating two kinds of crisis to which frequent reference is made in commercial parlance but which do not in any way threaten commercial air transport.

There is first the crisis which strikes at the economy as a whole, attacking in various degres all branches of activity according to their vulnerability. In all probability we have no call to fear such an eventuality in the immediate future, and if ever it did occur the means of economic action now open to governments encourage the hope that there will be no recurrence of a catastrophe similar to the Great Depression of pre-war years. It remains, however, an open question how air transport would fare in a general crisis: it may well be that even a slight recession in economic activity would have a fairly marked influence on the level of activity in air transport, since the major proportion of the airlines' customers is still composed essentially of tourists.

Secondly a state of crisis can exist in given industries whose very activity is threatened by the appearance and growing success of substitute products launched by new industries. This is in reality a technological crisis, which affects the structure itself of the economy and places the industries concerned before the choice of adapting themselves or disappearing. Such is obviously not the case in commercial aviation. Far from being doomed by technical progress, our activity is becoming stronger year by year, and flying is becoming more and more clearly the best means of transport on any routes where there are natural obstacles, such as seas, mountains, deserts or forests, between major cities. The growth of commercial aviation has been so rapid since the end of the war that ten years have sufficed to make air transport a serious competitor to what may still be called the "classic modes of transport". The difficulties created by technical evolution which commercial aviation is most likely to encounter will come from the resistance put up by these rivals to any changes in structure.

The figures for world air transport in 1954, recently published by I.C.A.O., and the comments on these results by Sir William Hildred, Director-General of I.A.T.A., can only strengthen our optimism as regards the prospects of development, both short and long-term, in commercial aviation. All traffic figures for 1954 show a substantial increase over those for the previous year, whether they are for passengers, mail or express goods. There is no hint of a "crisis" here. Indeed, to the outsider, the situation has never seemed so prosperous. However, as Sir William Hildred remarked with a certain dry irony, all figures are rising with one exception, that of the airlines' profits. Such is therefore the paradoxical situation to which we must give some attention: the financial difficulties encountered by the airlines —taken singly or as a whole—seem to be becoming more serious at the very moment when traffic figures would normally be interpreted as signs of definite prosperity. In view of this paradox it is permissible to speak of a crisis in commercial aviation. Our duty is to analyse with the utmost care the reasons for this situation, so as to be able to plan the appropriate action to avoid the threat of increased difficulties.

What then is the nature of the present difficulties?

They began to appear at the moment, about 1953, when the total volume of air transport offered became permanently superior to the demand, and they have grown through the joint influence of two factors: on the one hand the dynamism of technical evolution and on the other the competition existing between the companies.

The very nature of our activity prevents any form of stock-piling. An airline's sole interest is to fill its aircraft to the maximum. As long as there are more customers than it can handle, as was the case immediately after the war, there is no serious problem: it is easy to adjust the capacity offered to the demand by putting more aircraft into service and increasing the frequency of flights. But as soon as supply permanently exceeds demand—a state of affairs which is evidenced in the companies' figures by a decline in load factor—the nature of the problems confronting the airlines changes: the factors involved are no longer of a purely technical and financial nature, but include the many commercial aspects implied in the strategy of competitive enterprise.

The normal reaction of a company faced by a fall in the load factor of its aircraft is to stimulate demand among its customers by offering better service. And it is precisely on this question of quality of service that competition comes into play. Rate-cutting competition would have too serious an effect on airlines as a whole and would jeopardize the whole future of air transport. Incidentally it is because this truth was early and widely recognized that I.A.T.A. was entrusted, as one of its major tasks, with the regulation of rates throughout world aviation. Air rates, as fixed by I.A.T.A.'s Traffic Conferences, thus represent, both in principle and in fact, a compromise that is acceptable to the whole body of airlines. Their general tendency is towards a reduction, the most striking example of which has been the introduction of the tourist class and its extension to practically all air routes.

Since the quality of service offered has been found to be the only practical subject of competition, the next step is to examine what this actually demands of the airlines.

Improvements in service concern in essentials comfort and speed, service in the aircraft, the frequency of flight, and the convenience of timetables. All these points depend directly on the technical quality of the aircraft in service or on their number. Thus it is the most modern aircraft which offer operators their best hope of improving the quality of their service. All airlines have therefore launched into a policy of modernizing their fleets.

This policy is extremely costly. On the one hand modern aircraft are more and more expensive, both to purchase and to maintain. On the other, the rate of technical progress in aviation is so rapid that an aircraft becomes "outdated" in the space of four or five years. Consequently modernization of the fleet in a large airline has become a permanent process.

At this stage of our reasoning we begin to perceive that we are in a vicious circle. Modernizing an airline's fleet increases the traffic potential and enlarges the existing gap between

supply and demand; hence there are greater difficulties in filling aircraft and greater efforts are needed to improve service still further.

But as the surest and most effective way of achieving such improvement is to put aircraft into service that will outclass the competitors', the race for modernization goes on even faster. Some of the contestants in this race lose their breath, and the only reason why more of them do not fall by the wayside is that most modern governments provide financial support, in one form or another, for the company (or companies) which they have made the "chosen instrument" of their national air transport policy.

The strategy of competition as briefly outlined here obviously involves a great many factors besides equipment policy. However, it is essential to stress the vital part played by this one factor, if only to draw the immediate conclusion that the greater an airline's financial resources, the better will be its position in the international battle. This is doubtless the best explanation of the fact that, since the very beginning, the history of commercial aviation has been marked by a constant succession of mergers and concentrations.

If now we attempt to forecast how the situation in air transport will develop in the months and years to come, we must ask ourselves how the interplay will evolve between the two factors which we have seen at work: technical progress and inter-airline competition. As regards technical progress, it is quite possible to say without claiming prophetic powers or risking to be mistaken, that it is certainly not about to slow down. General acceptance of the turboprop aircraft is already a fact, and the advent of the pure jet airliner is awaited from one year to another. Tomorrow's aircraft will be faster and more comfortable, and will be able to carry more passengers than today's. They will also be much more costly, but the companies first to use them will score over their rivals. In the fleet modernization field there will thus be no major change in the overall picture painted above.

As for competition between operators, though it can be expected to continue to centre, as in the past, on quality of service offered, it may be that in the near future we shall see certain expressions of lively competition in rates in limited sectors, for example in the carriage of express goods on international routes or even of passengers in certain parts of the world. That will be the time to talk about a real crisis in air transport, but as this type of violent conflict cannot last, competition in the quality of service offered is likely to remain the airlines' permanent policy.

The difficulties facing air transport today are not, therefore, on the point of disappearing. It may even be that they will reach a critical level quite shortly. How will they be overcome? How will commercial aviation round the dangerous bend?

It is very hazardous to make forecasts at this point, though there is no harm in trying to assess what are the most likely developments.

First it may be stated that the feared crisis is one of growth: as demand for air transport grows, the airlines' problems will be more easily solved.

In this respect the present outlook for development in international tourist travel and international commercial exchanges is encouraging: the era of economic nationalism appears to be gone for good, as its return would be equivalent to a world catastrophe.

The efforts undertaken in Europe and on a world level to organize an international economic community may be expected to have favourable repercussions on the level of activity in commercial aviation. Moreover, measures may well be taken within the framework of this economic integration programme, to regulate competition in transport in general and in air transport in particular. The rational organization of commercial aviation in Europe should enable some of the major difficulties now confronting operators to be overcome. Without a voluntary effort at cooperation, the present difficulties can probably only be solved through the vicissitudes of an acute crisis which would cost a number of airlines their existence. The only companies to survive would be those able to absorb the harsh effects of competition thanks to their financial resources, or large-scale government support, or the existence of a national network protected from violent fluctuations in the market.

The situation as regards Air France, whose position in world and European air transport is well known, can be analysed accurately along the general lines drawn above.

As it has no monopoly, it has to face all kinds of difficulty on all kinds of route.

Its latest traffic figures indicate a rate of growth which is in excess of the mean rate in world aviation, since they show an increase of 20% in total aircraft mileage and 21% in passengers carried, between 1953 and 1954.

Its financial situation, however, is below the profit level, though this is merely an apparent paradox if allowance is made for the fact that its network of 155,000 miles is the longest in the world but is only covered 216 times a year. In addition, the company has had to make a considerable financial effort in order to complete the urgently needed modernization of its fleet. In order successfully to meet competition on all its routes, Air France has had to renew almost the whole of its equipment within the space of two years.

The company's prospects are on the whole good. Though the fact that it operates both an international network and a French Union network is a handicap in that conditions in the French Union are often far from permitting intensive and economical operation, the double network also represents a guarantee for the future. The French Union network is in fact experiencing a remarkable upsurge, in line with the economic development of the overseas territories, which does not seem likely to slow down for a number of years. This network represents a safety factor for the company, since it may well enable it to absorb the shocks of excessive international supply which is to be feared in a few years. Admittedly Air France encounters the competition of the well-equipped and well-organized French private airlines on this network, and it might be thought that this would be a source of additional difficulties for the flag carrier. But provided competition between the companies operating overseas services is organized rationally, these difficulties must be overcome in the interests of all and primarily of the French Union community, service to which we regard as our prime duty.

The organization of the French network, whose solution depends on both the airlines and the government agencies, is today the major problem in French commercial aviation.

Paris-Orly: an Air France *Constellation* being prepared for take-off.

Air Transport

A Bright Decade Ahead — If...

BY RALPH S. DAMON, PRESIDENT TRANS WORLD AIRLINES
KANSAS CITY

Ralph S. Damon (right), President of Trans World Airlines, in conversation with U.S.A.F. Lieutenant B. B. Aton prior to being taken aloft in a Lockheed T-33 two-seater jet trainer at Elgin Air Force Base, Florida, in May last year. Damon was one of about 70 business and industrial leaders visiting headquarters of U.S.A.F. Air Proving Ground Command.

The outlook for international air transportation for the next decade beginning in 1955 should be very bright and, barring a major international crisis or war, will exceed the fondest hopes of everyone in the air transportation field.

The reason I believe this is that the technological improvements of the long-range airplane, plus the advances which are now on the threshold, will make the world of international aviation even more of a neighborhood than it is today.

Faster, longer-range, larger and more comfortable airplanes are on the design boards, and prototypes in some cases are already flying for the manufacturing companies of many nations. The public appetite for travel, for tourism, for commerce and for understanding among people continues to grow. And the economic status and ability of much of the world continues to improve. Air transportation is now becoming a really widely accepted primary means of transportation.

Here in the United States, where an estimated 42,000,000 workers have an annual paid vacation of two weeks or more, the airlines have exceeded the railroads since 1951 in Pullman passenger mileage carried. Last year they overtook the railroads on coach passenger mileage (other than big city suburban commuting), and within a short time will exceed all rail travel combined (except possibly big city suburban commuting).

The introduction of world-wide air tourist travel with its reduced fares tremendously broadens the market.

There are, however, certain problems which the airlines must face and conquer within this decade in order to provide the peoples of the world with all these benefits.

First among these problems I would list the continually increasing requirement for cost efficiency within the airlines themselves.

Secondly, we must have reasonable treatment by the taxing authorities of the various countries, political sub-divisions and airport authorities so that the economies made possible by the airlines as a result of technological improvements and efficiencies can be passed along to the customer and not merely diverted to the taxing authorities. Unfortunate examples are already appearing in passenger arrival and departure taxes at airports which, if carried too far, will defeat the broad acceptance of air travel by passengers and shippers of cargo.

Another problem facing the airlines is the tremendous cost of the newer-type airplanes which, for the long-range large models, is tending to become so burdensome that the economics of the future are not too clear. In terms of American money the average transport airplane just before World War II cost $100,000. Today the average cost is well over a million dollars, and the turbo-prop and jet liners of the future appear to be going to cost substantially more. The newer airplanes are, of course, much more wonderful tools and can perform a much greater economic utility, but somewhere there will probably be a limit to the cost which an airline can pay for a piece of equipment, no matter how marvellous. The very problem of attracting the capital to buy it, which obviously cannot be obtained from the depreciation of the previous, cheaper-cost airplane, depends upon the earnings which the airline can save and the reward which it can pay to its investors to attract future capital.

For that reason one of the important criteria which all regulatory bodies should well look into is the ability of the airlines to reward their investors for their faith in putting in their capital, and no regulatory body can be adjudged a success unless under efficient management it permits such reward.

The basic success of the airlines to date has been in their ability to do a better job for the same or a lesser price to the customers. The fact that you can now travel around the world on tourist class for less than fourteen hundred American dollars, including the existing taxes to date, is the basic reason why air travel has expanded by such leaps and bounds. Added taxes, fees, or costs of any sort which will raise that price substantially will tend to dry the market up rather than to expand it and provide the benefits of neighborliness through air transportation to the citizens of the various countries of the world.

Air Travel — 1985

That Trans World Airlines proposes to weather all "crises" in air transportation is evident from the fact that on January 25th it organized a symposium at the Hayden Planetarium, American Museum, New York, the sole purpose of which was to engage in a kind of well-founded crystal-gazing—"What will Air Travel be like thirty years from now—in 1985?"

The occasion of the symposium was the 30th anniversary of inauguration of service by one of T.W.A.'s predecessor airlines, Western Air Express. Moderator of the meeting was the author of the article on this page, 57-year-old Ralph S. Damon, who himself has been connected with aviation for 37 years—first as a pilot in World War I, then as an aircraft manufacturer and airline operator, again as a manufacturer during World War II (Republic), and since January 1949 as President of T.W.A.

At the symposium T.W.A. announced a "cosmic contest" divided into two parts, each with cash prizes totalling $50,000.

To enter Part I, contestants must complete in 30 words a statement on "Flying is the way to travel . . . because . . ."

To enter Part II they must state in 200 words or less what commercial air travel will be like 30 years from now. Entries will be microfilmed and sealed in a special vault at T.W.A.'s new maintenance base in Kansas City, Mo.

In 1985 they will be opened and the winner will be picked—and if you are no longer alive, that's just too bad: but your heirs will get the money![1]

[1] The second part of the contest should cost T.W.A. nothing at all: supposing the company invested the $50,000 today with a yield of only 3½ percent a year, it could go to the bank 30 years from now and withdraw $102,500! And, taking compound interest into account the sum might be considerably higher!

Meanwhile, the symposium also served to tip entrants off about what they should say about the 1985 competition. Here are extracts from the statements made by some of the foremost U.S. aviation experts on this subject—and, it will be seen, they don't always agree:—

Hall L. Hibbard, Vice President — Engineering, Lockheed Aircraft Corp:

". . . Supersonic commercial transports will be flying regularly on the airlines. They will cruise at 1,500 m.p.h. . . at approximately 80,000 feet . . . Nuclear-powered passenger planes will be flying and might possibly be in airline service . . ."

Arthur E. Raymond, Vice President — Engineering, Douglas Aircraft Co.:

". . . The vast majority of the commercial fleet will consist of turbine-powered aircraft. I should not expect many of these to be flying supersonically because of the cost . . . Perhaps—who knows?—airlines will still be looking for a DC-3 replacement . . ."

Edward C. Wells, Vice President — Engineering, Boeing Airplane Co.:

". . . Predictions should be held to the next ten years . . . We will see jet transports widely accepted on airline routes, although the piston engine will still

This is what America's big commercial airports may look like, thirty years from now, in 1985. The sketch is based on predictions made at TWA's airline symposium in New York in January. – On the ground next to the transparent-domed passenger lounge is an airliner, not too different in size from today's transports but with different wing design and probably powered by some form of ramjet, as forecast at the symposium by Dr. Wernher von Braun, Chief of the Guided Missiles Division at the U.S. Army's Red Stone Arsenal. At the left background is a vertical take-off aircraft, which most of the scientists agreed would be important in 1985 aviation. How this type of aircraft would look in forward flight is seen in the plane flying past the control tower at right. Top left the moon . . . no change.

play an important role . . . Nuclear propulsion will for some time be limited to military use . . ."

General Joseph T. McNarney, President, Convair Division of General Dynamics Corp.:

". . . Long-range commercial air speeds will reach 1,500 miles an hour. Intermediate type aircraft with primary emphasis on such things as short take-off and landing, all-weather navigation and approach system, etc., may reach speeds of 850 miles an hour . . ."

J. Notman, President and General Manager, Canadair Ltd., Montreal:

". . . Traffic volume will have grown 15 to 20-fold . . . I expect this traffic to be handled by a fleet of aircraft three times the size of the present, with twice the average seating capacity and fifty percent higher average speed (i. e., 600 m.p.h.? —Ed.). All aircraft will be turbine-powered—by-pass engines for high-speed long-haul passenger traffic, propeller turbines for big load capacity and moderate speeds for coach and cargo traffic . . ."

Dr. Walter R. Dornberger, Guided Missile Consultant, Bell Aircraft Corp. (former military commander of the German Peenemünde experimental rocket establishment):

". . . We are thinking of rocket propelled airliners which will travel at speeds in the vicinity of 10,000 m.p.h. at an altitude of 150,000 feet . . ."

Dr. Wernher von Braun, Chief of the Guided Missiles Division, U.S. Army Arsenal, Red Stone, Alabama (and former scientific head of the German Peenemünde experimental rocket establishment):

". . . By 1985 I think we can expect to see commercial airliners flying at altitudes of 60,000 to 80,000 feet at speeds in excess of 2,000 miles an hour . . . Airliners will use novel types of jet engines—atomic ramjet engines . . . For shorter distances turbojets and maybe even turboprop airliners—atomic-powered or operated with conventional fuels—will be used . . ."

G. S. Trimble, Vice President — Advanced Design Glenn L. Martin Co.:

". . . (I) believe that essentially all commercial transportation in 1985 will be via air in vehicles operating on principles not yet conceived . . ."

Mass Transportation by Air Lies in Aircoach Expansion

BY CAPTAIN EDWARD VERNON RICKENBACKER,
CHAIRMAN OF THE BOARD, EASTERN AIR LINES, INC., NEW YORK

Through the past year Eastern Air Lines put into operation the first stage of a new plan of operations designed to convert air travel into a system of mass transportation.

The specific objective was to broaden the base of airline traffic by:

1. The operation of full-fare high-speed "express" service on multiple schedules between major terminals to attract more high-priority business and personal travel; and
2. The extension of low-cost Aircoach service to the "grass root" levels where high volumes of traffic are now moving principally by private automobile.

As final units were delivered in the *three new fleets* procured under the company's $180,000,000 re-equipment program, these operating changes were introduced on a limited number of key routes. The first steps were the introduction of every-hour-on-the-hour schedules between New York and Miami and the conversion of approximately 50 % of all trunk-line operations to low-fare Aircoach services.

Initial results of the new operating program, together with the greater capacity of our new fleets, enabled Eastern Air Lines last year to register an over-all increase in traffic approximating twice that of the industry's average percentage gain for the year (23 % vs. 12 %).

The largest gains in current records for the system are registered in the Aircoach services. Although Eastern Air Lines for years has been the industry's leading operator of low-fare Aircoach service, volume in this category has doubled in the last 12 months.

It was not until January of this year, however, that all elements of our new program and the full capacity of Eastern's three new fleets, were in full operation for the first time.

The results showed:

Passengers Carried	31.13 % increase
Passenger Miles Flown .	29.71 % increase
Passenger Revenues ...	25.13 % increase

At the Miami Terminal, through which Eastern is now operating 120 schedules in and out every 24 hours, traffic handled during January was up 25 % over the record set for this month a year ago and was more than 60 % of that port's total traffic.

In my opinion, based on the results demonstrated by Eastern and the industry last year and on a realistic evaluation of the potential air traffic market, the *airlines will displace the overland buses in 5 years and the railroads in 3 years as the country's primary passenger carriers.*

I believe the airlines are heading into the greatest growth period in their history. To equip Eastern Air Lines for the expansion ahead, these policy decisions have been made:

1. To increase capacity on all main north-south and southwest trunk airlines and to step up "express" schedules into the 350–400 m.p.h. "pre-jet" range to provide a specialized service, at full fares, for "high-priority" business and personal travel. To accomplish this, Eastern Air Lines has placed orders with the Douglas Aircraft Company for a fleet of 20 advanced DC-7B airliners costing $40,000,000.

   The original 12 units of this fleet, ordered some months ago, are to be delivered during the coming summer. The final 8, for which orders have just been issued, are scheduled for delivery in mid-1956. The bulk of this fleet will be concentrated on the "express" schedules.

   (Like all other new aircraft purchased in this program, the new DC-7B's will be paid for out of profits, reserves for depreciation, and proceeds from an existing low-interest bank loan.)
2. Beginning late this year, as the new DC-7B units are integrated into the full-fare express service, the Company's Lockheed *Super Constellations* will be converted for a greatly improved—and greatly expanded—aircoach service.

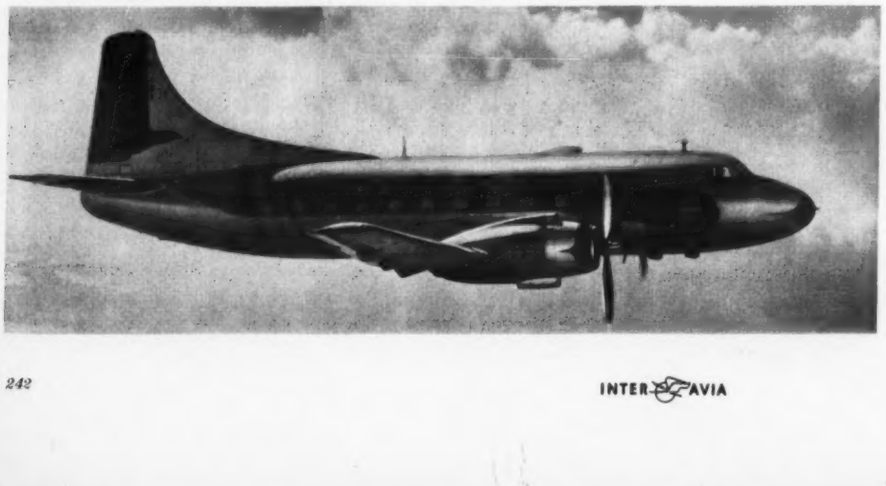
   By the end of 1956, this program will give Eastern a Super-Aircoach fleet of 48 of the largest, most modern four-engined airliners in the country. This fleet will enable Eastern to provide low-cost air service over a 24 state trunk-line network, serving all principal cities from the Atlantic Seaboard west to St. Louis and San Antonio, and from the Great Lakes south to Florida, the Gulf Coast and Puerto Rico.

The capacity of Eastern's present fleet of 119 airliners (60 twin-engine 40-passenger Martin 4-0-4 *Silver Falcons;* 19 four-engined 60-passenger Lockheed 749 *Constellations,* 13 four-engined 88-passenger Lockheed 1049 *Super Constellations;* 16 turbine-compound powered 88-passenger Lockheed 1049C *Super Constellations;* and 11 four-engined 68-passenger Douglas DC-4 *Skymasters*) totals approximately 3½ billion seat miles per year. By the end of this year, Eastern's total airlift capacity will be increased to 4 billion seat miles and to approximately 5 billion seat miles by the end of 1956. With the full program in operation it is anticipated that 70 % of this total will be in Super-Aircoach service.

One important factor not computed in this projection of Eastern's growth is *the part air freight is certain to play in the expanding period ahead of air transportation.*

From any viewpoint of the national welfare, for the needs of the country's growing commerce and industry as well as for our national defense, a properly equipped and economically sound air freight industry is absolutely essential. Air freight has a place of high priority in Eastern's planning. Over the past several years, our engineers have been working with manufacturers looking toward development of a large, economical air freighter. Until now, however, the reluctance of the aircraft manufacturers to pioneer and the inability of the commercial industry to finance the develop-

E.A.L. has a fleet of sixty 40-passenger Martin 4-0-4 twin-engined medium-range transports for "intercity" services, which feed passengers from smaller centres to main terminals for the express flights.



Captain "Eddie" Rickenbacker has acquired a rare distinction in air transportation: even during the post-war air transport recession of 1947–to–48 his airline kept on operating in the black.

Today the 64-year-old airline chief, American ace-of-air aces of World War I (26 victories), ex-racing driver, automobile and aircraft manufacturer, looks forward to a continued expansion of air travel as much as ever.

At the end of January he told the Sales and Advertising Club of Baltimore of his company's future equipment plans—far ahead of those outlined in the article on this page. He referred to the $180,000,000 programme started three years ago and calling for sixty Martin 4-O-4s, thirty Lockheed Super Constellations and twenty Douglas DC-7Bs. And he continued:—

"To date we have paid two thirds of that bill. Even before the remaining units of these fleets are delivered—the DC-7Bs with turbo-compound engines—we are forced to plan for superimposing on these fleets entirely new fleets of turbojet and turboprop aircraft at an additional cost of $200,000,000 within the next seven or eight years.

"Should we be successful in inducing an aircraft manufacturer to build an efficient air freighter, this will require an additional fleet and an additional investment of some $ 50–to–$ 70,000,000. These are essential expenditures. They must be made if we are to continue to advance . . ."

Mr. Rickenbacker obviously does not fear a crisis in air transport in the near future.

ment of an air freighter have blocked progress in this direction.

However, the current recognition by the military services of their urgent need for a transport vehicle that can move with the speed of their atomic attack will, I hope, accelerate the development of this vital element of our national air power.

Equally important is the necessity for providing an adequate network of airports throughout this country. In my opinion, while President Eisenhower is sponsoring the allocation of $100,000,000,000 for a 10-year road-building program as an aid to commerce and industry as well as the national defense, these same needs could be served by the government's investment of only $10,000,000,000 for the construction of a national network of strategically placed airports capable of handling fleets of these giant air freighters.

For its express services, E.A.L. operates thirty 88-passenger Lockheed 1049 *Super Constellation*-type aircraft, as well as nineteen of the earlier Model 749 *Constellations*. Following delivery of twenty Douglas DC-7Bs now on order, Captain Rickenbacker proposes to utilize the *Constellations* for a vast aircoach expansion programme.

Such an airport network could assure vital airlift capacity flexibly geared to any national emergency where highways and earth-bound communications would be disrupted by an enemy attack.

An industry force of freighters, capable of meeting the demands of commerce in peacetime between the 25 key cities of the United States would inevitably be the country's first line of supply-defense in any emergency.

The Air Hostess Told Us...

Crisis in air transport? says Esmeralda, making fun of us because we're trying to discuss a serious subject. The only trouble in air transport is the paper work, our Favourite Air Hostess explains, and that can easily be simplified—in fact I would make the world's most efficient paper work eliminator, if they paid me enough.

Take December 21st, last year, she boasts, when I happened to work for Panair do Brasil. A lady passenger for Europe turned up at Rio airport with a ticket made out in the name of Senhora Maria Teresa Francisca de Assis da Conceiçao da Rocha Rilomena das Necessidades do Sagrodo Coraçao de Jesus Pereira da Cunha.

And what did you do? we ask. Cut down the paper work, Esmeralda says. I put her down on the passenger list as Maria Cunha, and she arrived in Europe all the same.

What's in a name? she declaims. You know the story about one of the letters Draft Board 46 got at 155 East 88th Street in New York during the last war? It said:—

Dear Sir,

I wish to notify that I am now citizen and have changed my name from Sergio Philippo Eduardo Gonzalez to Sergio Philippo Edward Gonzalez.

Thanking you for any inconvenience.

(Signed) Sergio.

Or the probably quite untrue story about one of Britain's aviation pioneers, Wing Commander Thomas Reginald Cave-Brown-Cave, who until 1950 was Professor of Engineering at Southampton University? Now one day the Professor went on a trip to South Africa, Esmeralda relates, and met lots of people there. On one occasion the introductions weren't handled very smoothly, and he had to introduce himself to the man standing next to him.

"My name is Cave-Brown-Cave", he said politely.

"You don't say," replied the South African, "in that case mine is Home Sweet Home!"

"Crisis" is Too Strong a Word

BY DON CESAR GOMEZ LUCIA,
MANAGING DIRECTOR, IBERIA LINEAS AEREAS ESPAÑOLAS

The men with the credit balance: left, the author, Iberia Managing Director César Gómez Lucía; right: Iberia Secretary-General Juan B. Vinicgra.

"It's all very well for Iberia to talk . . .", may be the reaction of air transport heads in both Old and New Worlds on reading the following remarks by their colleague of Iberia and comparing the Spanish airline's balance sheets up to 1953 with their own. Even in the two dark years of the immediate post-war crisis Spanish air transport met with no difficulties. Here there were no complaints about empty seats and cancelled bookings, frequent at that time in Europe and the United States. Business went on increasing, and **Interavia** commented on Iberia's favourable situation as long ago as 1950 (No. 1-2, 1950, p. 49: "Payload Factor 105 %").

Until very recently there had been no changes since the 1949 annual report then analysed. Iberia's traffic doubled, and revenue and profits increased seven to eight-fold.

How did Iberia arrive at such startling results? It certainly has never used luxury aircraft or served nectar and ambrosia on its continental or African routes. Even today, it still runs these flights with old Douglas DC-3s and a few DC-4s, and the former often do not even carry hostesses. But the following numbers of passengers were recorded, for example, on the most densely operated domestic services in 1954; Barcelona–Palma 120,114; Madrid–Barcelona 96,216; Madrid–Palma 20,958; Valencia–Palma 14,994.

The 1950 assessment thus still holds good today. Yet Iberia, though extremely well run, is no wizard and uses the same ingredients as the other airlines. It owes its preferential position to a number of factors: long distances in the Iberian Peninsula, bad highways and railroads, and finally its excellent technical service.

Iberia's activities recently also struck the American "Time Magazine", which wrote on January 31st, 1955: "Iberia, the Spanish government's airline, has more passengers than it can handle. Almost every seat on every flight is filled; often the only way to wangle a ride is by a special letter of introduction to the pilot. Last week Iberia proudly announced its gross for 1954: $12,500,000, an alltime record. With more planes gross income could have been twice as much . . . The reason for Iberia's booming business is simply that flying is the best way to get around in Spain. By rail, the 312-mile trip to Barcelona from Madrid takes all day, costs $9.50 on a rattletrap train. Highway travel is just as bad—over narrow, pot-holed, mountainous roads. But in one of Iberia's 32 British and American planes (mostly Douglas DC-3s and DC-4s) the Barcelona trip takes less than two hours, costs only $11.50 . . . Today, under President Jesus Rubio Paz . . ., Iberia is beginning to expand into the transatlantic market (not strictly correct; it began long ago in the Latin American countries — Editors). Last August the line inaugurated its first U.S.–Madrid flight with three nonstop Lockheed **Super Constellations,** bought entirely with its own profits. Says President Paz, whose three new **Super Connies** are named the **Pinta, Nina** and **Santa Maria,** after Columbus' tiny fleet, 'Our crossings will build a sort of aerial bridge, subtle and invisible, on the common ground of friendship.' "

Only the near future will show whether the Iberia President's calculations are correct; at the moment the aerial bridge between Madrid and New York is not paying well, is in fact more of a burden on the profit and loss account. Load factor dropped from 84 % in 1951 to 72.3 % in 1954, or, to put it more plainly, load factor on the domestic services continued to exceed 80 %, but fell from 68.9 % to 60.3 % on international routes—despite the fact that the Madrid–New York service was operated for only five months in 1954.

Don César Gómez Lucía, Iberia's real moving spirit, is no conjurer, but he does know his arithmetic. If he has been able to keep his company on a rising curve for so long, it is because he has known how to get the best out of his goodwill. Rest assured, he is counting on this goodwill in the future . . . and will not come out the loser in the end.

So much by way of introduction. Over to the author.
Editors

The word "crisis" should be used more carefully than is often the case today. For example, there should be no talk of a "crisis in air transport". until unfavourable factors become clearly recognizable from one year to another, such as a sensible falling off in passenger volume or a halt in the improvement of flight safety or—to take another example—a reduction in regularity of traffic. If, however, despite the boom throughout the transport business, the airlines cannot pay their way, it is time to look into matters. The trouble then probably lies in deficiencies of management. To avoid errors here, it would be well to analyse certain elements in air transport. Basically these tally with those of other forms of transport and cover vehicles—i. e., aircraft—route network, personnel and finally the combination of all these factors.

*

Modern aircraft, of which there are far fewer types than is generally believed, are available to all air transport undertakings who can afford them. The same applies to engines, of which there are even fewer different types. In a word, there can be no fundamental differences between airlines, large or small, as regards flying equipment. The same does not apply to the railways or shipping, whose rolling stock and fleet show national peculiarities.

Yet airlines do all they can to appear distinctive. For instance, they have of late insisted on modifications to the aircraft they use, to obtain slight speed increases, though the latter seldom exceed about 15 m.p.h. This meagre result suffices, however, to prevent the urgently needed standardization of flying equipment and leads to shorter depreciation times. Both inevitably have unhealthy effects on operating costs.

The methods of flight safety are beyond the influence of the airlines and are well on the way towards world-wide standardization. Aircrews perform their duties to automatic rules, which may be compared to ritualistic actions carried out throughout the world with the same words and gestures. This standardization has already reached such proportions that the air traveller can scarcely distinguish between one airline and another. In addition, rates and conditions of carriage are governed by

Network operated by Iberia, Spain's flag carrier.

Demand and seating capacity in air transport

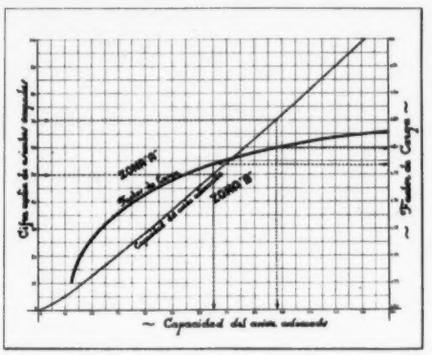
If passenger demand in air transport followed the laws of probability, it would be possible to ascertain for every **mean value of seats occupied** ("Cifra media de asientos ocupados") a **suitable seating capacity** ("Capacidad del avión adecuado"). An aircraft with the optimum seating capacity indicated by the thin curve would fail to meet demand in only 2‰ of all cases.

The diagram also shows the **load factor** ("Factor de carga"), i. e., the percentage of average number of seats occupied to the seating capacity.

For example, for an average of 50 passengers (left-hand ordinates) the optimum seating capacity of the aircraft is seen to be 65 (abscissa). The corresponding load factor is 0.77 (right-hand ordinates). For an average of 70 passengers, however, an aircraft with 88 seats should be chosen, whose load factor would then be 0.795.

If the average load factor obtained in practice is above the thick curve (zone A), the aircraft's seating capacity is too low. In zone B, the capacity is too high.

Even though actual passenger demand does not always follow the laws of probability, these laws (and the curves derived from them) must still be used as a basis for theoretical calculations. **The diagram illustrates the need to change the size of the aircraft and/or the frequency of flights when the actual load factor falls below 65 % or rises above 82 %.**



agreements, and an operator's "brain-waves" are not patentable. If they are good ones, they are immediately taken over by his competitors.

*

The travelling public knows that all airlines have much the same to offer, that comfort, safety and speed are basically the same, particularly on international routes. A passenger's choice of airline is therefore largely a question of chance, aside from such motives as curiosity or national sympathies. He may perhaps prefer Scottish salmon to lobster mayonnaise, or champagne to Moselle. But for the rest . . . ?

For the rest an airline operator's efforts should be limited to seeking new methods of reducing prices. No passenger has ever yet travelled by air for purely culinary reasons (if the food were too good, it would detract from other comforts and hamper digestion . . .). Only when a passenger is already decided to take the quickest means of travel may meals have a certain secondary attraction.

If in this undeniable uniformity an operator still seeks to make his airline pay better than the others, his only hope of substantially cutting costs (per mile flown) is "mass carriage". But even here his possibilities are relatively restricted. No airline can send its aircraft out on any route it pleases. In domestic traffic it must content itself with the routes approved by its national government, and in international service with those provided for under inter-governmental air transport agreements. The real bosses are thus the diplomats, whose skill—or lack of it—decides the economic health of national air transport.

There is only one field in which the operator can develop his own initiative, namely in measures to "spread" his traffic volume. Everybody knows that this volume is by no means constant throughout the year. Passenger numbers vary from month to month, even from day to day, and "dead seasons" alternate with peak periods when traffic cannot be handled by ordinary means. It is therefore a test of the operator's adaptability how he deals with the constantly changing demand without working uneconomically. To run aircraft of different capacity on the same routes is virtually out of the question. The only solution therefore is to vary the frequency by increasing or reducing the number of flights. Too drastic a reduction in frequencies, however, may well reduce demand.

Most operators have an understandable aversion to this method and prefer to use *special fares* worked out on the most varied bases: e. g., age of the passenger; number of accompanying persons (family tickets); season; specific days of the week, hours of the day or night; degree of comfort offered in the aircraft, etc. None of these measures really provides an economic solution to the problem. It may even be said that special rates add a further complication in that they reduce the cost of travel for those passengers who would quite happily have paid the full price, while by and large failing to attract the new class of traveller at which they are aimed.

*

The factors on which air transport today bases the calculation of its rates appear to be somewhat doubtful ones. "Production" is reckoned according to aircraft miles, and fares calculated according to the number of seats available. Calculations are thus based on the whole aircraft, without allowance for the unused, unproductive space. Thus the lower the load factor, the more inadequate become the rates. It may therefore happen that traffic receipts do not even cover the pure production costs[1]. Losses then naturally increase with the frequency of services. A reduction in frequency thus becomes imperative. While it may be true that "all traffic creates new traffic", it is no less true that traffic ruins traffic.

The mismanagement of economic affairs in air transport is thus in part due to the high degree of competition between airlines. The resulting minor crises must be regarded as teething troubles, perhaps necessary to the healthy growth of air transport.

*

In the solution of these problems the airline operator must work largely by instinct, as precedents are lacking. The experience of other transport branches does not necessarily apply to air transport. The railways have sole control over their own organization, and in shipping the owner almost always has his ships built to his own requirements. Air transport, like road transport, depends on government decisions and does not build its own equipment but buys it ready-made.

One thing is certain: in the present state of civilization there can be no lack of demand for air transport. And as long as there are customers it would be foolish to talk about a crisis.

[1] Production costs cover fuel and lubricants, landing charges, aircraft depreciation, maintenance, salaries, passengers' meals etc.

Commercial Aviation in the Forefront of Progress

BY EMILE DELCLAUX,
ASSISTANT FINANCIAL MANAGER, AIR FRANCE

Weapons in the paper war: documents required for accounting between Air France and British European Airways for every ticket sold by B.E.A. but used on an Air France aircraft.

As everyone knows, commercial aviation is in the forefront of progress. This privileged position cannot be maintained without effort; it is easy to imagine the difficulties of all kinds which the engineers have to solve in order to produce the admirable machines which are the pride of all, ever more powerful engines, propellers that are real gems, and cleverly designed undercarriages.

However, the initiated know that these are not the real difficulties, that the problems to be solved are of a different order; to choose one example out of a thousand: how many toilets should there be in an aircraft? Where should they be situated, in front, at the rear, or in the middle? It will immediately be realized how perplexing such a major problem can be and that the only thing to do is call together fifty or so experts in, say, Honolulu, to seek a solution. Naturally, after two weeks of exhausting discussion it will be concluded that the problem needs further consideration and that a fresh meeting should be called—in Venice, for instance. This time it is recommended that delegates be accompanied by even more specially qualified experts. Unfortunately, even the new meeting fails to bring a solution, as opinions are very diverse, ranging from a single toilet to individual toilets. After three weeks of impassioned debate it will have to be reported that no agreement has been reached and an appeal made to the highest civil aviation authorities. The latter will then decide, after hearing the experts, that there should be two toilets in an aircraft, one for Ladies, the other for Gentlemen, that they should be in the rear, and that both first-class and tourist passengers should have access to them, with however, the following proviso: in one direction, tourist-class passengers should pay a mileage supplement during the period of occupation, calculated according to the speed of the aircraft; in the opposite direction, first-class passengers should pay the same charge. This is, of course, designed to safeguard the interests of each company. The decision, greeted with general enthusiasm, will be set down in resolution 55-987223 ter, which will come into force in six months time, unless the government of Pota-

Air France's mail completely fills a roomy truck every day.

land considers that it prejudices its vital interests, which would upset everything and oblige the unfortunate experts to meet again to seek another solution, this time perhaps in Mexico City.

Needless to say, the passenger has no idea of these difficulties. His only surprise at the end of his journey, during which he has paid for the bus ride, his baggage, airport charges, his beer and his whisky, is to find the coin refused when he offers to pay for the ladder by which he descends to the ground. Nevertheless, he is delighted with his journey, with the excellent meal he has had, the steward's attentions, the hostess's smiles, and thanks the company for all its care. But his thanks would be warmer still if he knew that when he leaves the aircraft his trip is only beginning, as he has handed in his passage ticket, an essential raw material, more precious to the company than uranium.

This ticket will now be examined by doctors, analysers, statisticians, photographers, specialists of all kinds, who will dissect the passenger from the colour of his eyes to the reason for his journey, taking in on the way his weight and the number of his children. Then, along with a mountain of other papers and documents, blue, yellow, large, medium and small, it is passed along to the book-keepers by a man whose chief preoccupation is to keep himself in trim, like a Smithfield meat market porter, so as not to succumb under the weight. Now begins the most exacting part of the journey, namely the preparation of the invoice. It will be taken, examined from all sides, dissected by the book-keeper, his assistant, the head of the department, the head of the section, each of whom in turn has a different idea of the passenger and the most rational way of treating him. After consultation of tariffs, timetables, I.A.T.A. resolutions, service manuals and special agreements, the invoice will be completed and timidly sent to the other end of the world, thus presenting traffic agents with another problem in the weight and volume of the invoices to be carried. Finally, after minute examination by another set of book-keepers, department heads etc., who will naturally have quite different ideas and will again have to consult the rates, timetables, I.A.T.A. resolutions, manuals and special agreements — which will not necessarily be the same one—the invoice will be returned, with the necessary comments, to its point of departure. After five or six journeys the passenger may, if all goes well, enjoy his well-earned rest. All this, of course, necessitates a large and specially trained staff. It should be possible to calculate mathematically in what year the whole population of the earth will be employed by the airlines, which will at least have the advantage of abolishing unemployment and facilitating the work of the sales promotion services.

The object of these lines, written in a somewhat flippant manner, is to arouse the reader's attention and cause him to reflect on the incredible complexity we have arrived at in the administration of air transport. I believe that if we wish commercial aviation to remain "in the forefront of progress" and to continue to grow, it is absolutely essential to do away with the present complications and find simple solutions to our problems, which are complex enough in themselves.

Air Transport Diagnoses its Ills and Prepares for Tomorrow

BY PIERRE M. GALLOIS, PARIS

The views expressed here seem to contradict those which many air transport operators would wish to see. But only apparently... Pierre Gallois, well-known French aviation expert, who for many years has edited the "Air Transport" section of the official publication "Forces Aériennes Françaises", also regards certain signs in present development with anxiety. However, he too believes that a crisis in air transport can be avoided, if . . . *(Editors)*

Despite the climate of luxury created by the value of its equipment, the vastness of its commercial organization, the air of relative wealth exuded by its employees and above all by its users, commercial aviation pales when it comes to its annual balance sheets. Since it is the fruit of power and riches, it forgets that it is also a daughter of necessity.

Slowly but surely the margin of revenue over operating expenditure is shrinking. As it is "growing up", the air transport industry no longer shows brusque variations in its statistics, and the tendency towards stabilization of its traffic is a steady one. So is the falling off in load factors, and the shrinking in profit margin, which will turn into a loss, small at first, but becoming larger and larger if the apparatus continues on its present course (table No. 1).

United States airlines alone operate more than half of total world air transport. They have developed under such special and such favourable conditions that they have long outpaced those of other countries. Yet present anxiety comes from the West. Last year, U.S. airlines' traffic increased by 15% over 1953. Revenue was 8% higher and, for the first time, local services made a profit. It should be noted that it is not so much that the domestic market has expanded but that there has once again been a transfer of business from rail and road to air. The railroads recorded a drop of 9% and bus lines of 12%. However, air carriers are not rejoicing too much over this new victory. They note that traffic on the main domestic routes increased by only 11% and that, though revenue rose by 10%, expenses had jumped 12%. True, America's international network offered a certain compensation, since here revenues exceeded expenditure. But this more favourable result was due to a marked increase in the amount of mail carried by air (nearly 40%) and, above all, affected only a little more than a quarter of the commercial aviation activities in the United States, where domestic operations form the lion's share and have become the example and criterion for world air transport.

In 1953 the economists in U.S. commercial aviation announced that 1954 would be a crucial year. The war in Korea had falsified past results and given a fillip to profits. Hence 1954 should be watched carefully for signs of financial health based solely on the peacetime market. Even in 1953 the profit margin had been found to be less than 10%. The only solutions were to increase rates, maintain subsidies and expand the market. The C.A.B. agreed not to reduce fares, but financial assistance was cut to $80,000,000 (30% less than the previous year). Demand increased by 15%, but this does not appear to be sufficient to reverse the tendency of the past four years for expenses to outstrip revenues.

A rational paradox

In Britain, the results for the Corporations' last business year seem as paradoxical as the numbering of London's streets. Despite its equipment difficulties, B.O.A.C. made an operating profit of £2,000,000. B.E.A., on the other hand, having scored a success with its Vickers *Viscounts,* increased its traffic by 23% and had a completely accident-free year, yet lost more than £1,500,000 ($4,200,000) and increased its deficit by 22% compared with the year before. B.O.A.C., who lost its flag aircraft in the *Comet,* has never before attained such a profit. B.E.A. which has never before increased its traffic so rapidly, has never presented a worse balance sheet. The paradox is an apparent one only. B.O.A.C. slightly increased its traffic, reduced its staff and increased their mean output, and succeeded in using the tourist class without detriment to its first class. Having lost, through the grounding of the *Comet,* 25% of the carrying capacity it had counted on for 1955, it can look with satisfaction on a favourable balance sheet, while preparing for a less favourable future. The reverse is probably true of B.E.A. The renewal of its fleet has considerably increased its "investment" heading, as well as that of interests payable. But the *Viscount* has been a success and has increased profits by the equivalent of 180,000 miles. The real reasons for the deficit are inherent in Europe and in the nature of the services operated by the Corporation. The introduction of tourist class services in 1953 reduced receipts by 8.5%, while the operating economies they produced amounted to only 6%. A network of short-stage routes is costly in fuel and landing charges.

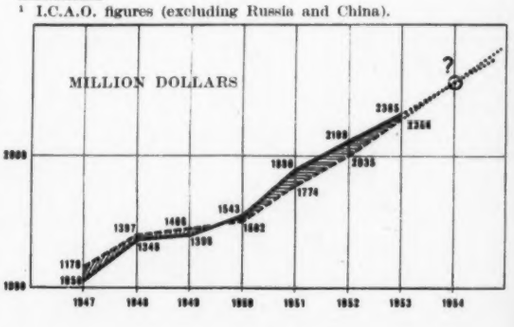
K.L.M. operates a fleet of 85 aircraft on a network of 145,000 miles serving 68 countries. Traffic figures for 1954 were 17% higher than for the previous year. A small profit was made despite the purchase of four *Super Constellations* and four Convair 340s and the interest on the loan granted by the International Bank for Reconstruction and Development. In 1953 Sabena announced a deficit of 1.5% of its turnover, attributable to non-paying services

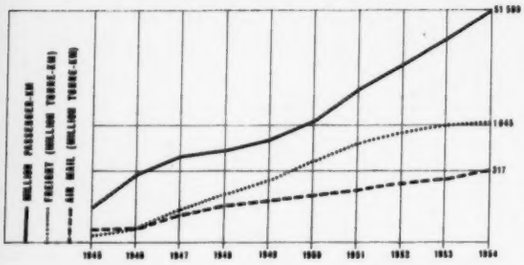
REVENUE AND EXPENDITURE IN SCHEDULED AIR TRANSPORT [1]

During the 1947 to 1949 crisis, costs in air transport exceeded receipts. If present trends continue, the same situation will arise again within a few months.

------- Operating costs
——— Revenue
····· Trend

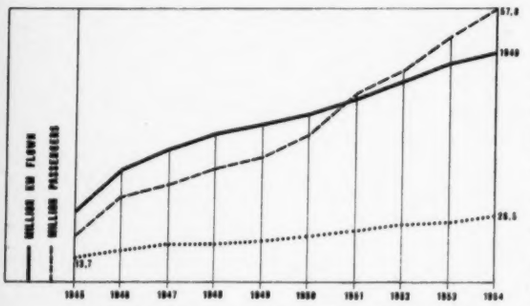
[1] I.C.A.O. figures (excluding Russia and China).





DEVELOPMENT OF THE THREE CATEGORIES OF TRAFFIC IN AIR TRANSPORT (SCHEDULED AIRLINES)
The curve for passenger traffic rises much more steeply than those for freight and mail.

——— million passenger-km
····· freight (million tonne-km)
------ mail (million tonne-km)



DEVELOPMENT OF SCHEDULED PASSENGER TRAFFIC
In ten years from 1945 to 1954 averge seating capacity per aircraft (dotted line) almost doubled: from 13.7 to 26.5 passengers.

——— km flown (in millions)
------ passengers (millions)
····· average seating capacity per aircraft

of public interest in Africa and to the reduction in postage rates.

Over-equipment and penalty of territorial possessions

In France the situation in commercial aviation, though not critical, is very difficult. Air France announces a deficit of more than 3,500,000,000 francs ($10,000,000). The transport capacity used on the services to the Far East and Indo-China during the fighting is now surplus and nobody knows what to do with it, as the French air fleet is over-equipped. On a different scale, the Far East situation plays the same part in France as it did in the United States three years ago. Last year nearly 40% of the traffic on long-distance routes in the French Union concerned Indo-China. In 1953 some sixty twin-engined and four-engined aircraft or 20% of France's civil air fleet were engaged to full capacity in this operation. What is now to be done with this surplus capacity? An analysis of Air France's traffic results for 1953 shows that total increase over 1952 was only 8%. The Association of Private Air Carriers—which groups the five major "non-skeds"—announced traffic figures for 1954 largely similar to those for the previous year. No sign here of any great expansion in the market. On the international network competition is keen, and newcomers are increasing, with Japan and now Germany, and the expansion of Italian and Spanish services. Whether the expected annual increase of 15% will be obtained remains to be seen. Within the French Empire the battle is no less fierce.

General conditions in world air transport and circumstances peculiar to France and to the management of Air France are the reasons for these difficulties. Seasonal variations in traffic, the Universal Postal Union's decisions on mail rates and the severity of international competition are sources of difficulty for all air transport operators, particularly in Europe. And M. Max Hymans has described Air France's special difficulties as lack of standardization in its fleet, which includes no fewer than nine different aircraft types, the obligatory operation of unprofitable services of national importance, the purchase of new equipment, with the investment this requires, and finally the more or less regulated competition between "chosen instrument" and private airlines on the French Union network. These troubles affect a given airline only, not the air transport industry as a whole.

Air France's worries are sufficiently specialized to warrant their separate study. Though Africa may play a large part in its future, at present it is a heavy expense item in the accounts not only of the airlines but also of the country's whole aviation organization. In less than an hour after take-off from its base, a Belgian, Dutch, Swiss, Danish or even, to a certain extent, British commercial aircraft has left national territory and is flying over foreign areas. Belgium, Holland and Switzerland, to mention only the most striking examples, have only a small number of commercial airports to maintain, and their airways are in proportion to the size of the country. The French problem is a different one. Air routes stretch over an area 3,700 miles long by 600 to 1,200 miles wide and serve more than a hundred airports, all of which have to be constructed and maintained by the Metropolis.

Like its British counterpart, French commercial aviation operates under a further handicap, its use of national equipment. Everybody knows the financial burden imposed on B.O.A.C. by the use of the Avro *Tudor* and what the *Languedoc* and the Latécoère flying boat cost the French Government, as well as Air France. But the two governments found themselves in the following dilemma: either national aircraft had to be used, tested and progressively improved on the commercial network, or foreign equipment had to be bought. Unless new aircraft can be proven under normal operating conditions, the industry must give up trying to produce commercial aircraft.

The two countries have been handicapped by a war during which the development of transport aircraft was pushed to extremes on the other side of the Atlantic, whilst it was greatly restricted in Britain and stopped altogether in France. The gap produced was so wide that it seemed almost impossible to catch up. British engine designers have invalidated these doubts, but despite the ability shown and the high technical qualities of certain commercial equipment, large-scale production and large-scale utilization, with all that can be learned from it, are decisive on the technico-commercial side. Quantity has a definite effect on the commercial quality of flying equipment. Because countries like Belgium, Holland, Switzerland, Italy and Spain have decided against building their own heavy aircraft, they are free to form their commercial fleets from the best aircraft, regardless of their country of origin.

The cost

Such is the present aspect of air transport. It cannot be studied within the narrow framework of the operating companies, but only on a national scale or over large regions of the earth.

If the total revenue of the Western world's major air transport companies is of the order of $2,860,000,000, the financial assistance granted by governments in the form of mail subsidies or more directly by covering deficits or even purchasing aircraft, will be around $286,000,000, or 10% of the total revenue. This is a low figure, considering that air transport is only entering its fourth decade and that twenty years ago subsidies were on a very much higher level.

Let us look for a moment at the annual subsidies granted to American commercial aviation, the most economically sound but also the one for which geography, national economy, demography and industry combine to provide the most favourable conditions. During the 1953 fiscal year, the Government paid rather more than $77,000,000 in direct subsidies to U.S. airlines. During the same period assistance to merchant shipping amounted to $201,000,000, to agriculture $2,229,000,000, to overseas

Air transport between Europe and Africa: a Bristol *Britannia* over Tripoli harbour.

countries $5,914,000,000 and the purchase of military aircraft to some $7,416,000,000[1]). In addition, the C.A.A. budget for 1953 was $143,000,000, of which $106,000,000 covered salaries of personnel in American civil aviation, $11,000,000 was for the installation of navigation aids on Federal airways and some $20,000,000 in aid for airports. In total, expenditure approached the subsidy granted to merchant shipping.

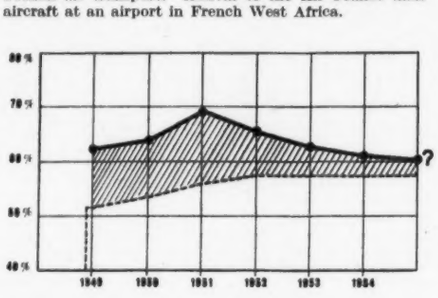
In France, where some 40,000,000,000 francs a year are spent on subsidies, the civil aviation administration, airways and airports, prototypes and research for commercial aviation, each of the two million users of the French network is virtually handed the sum of 20,000 francs. The figure is higher than the world average, but this is the price of operating over such a vast area which covers territories of very unequal economic development.

The American case

The general reasons for the strength of civil aviation in the United States are well known. It need only be added that traffic density is much higher than anywhere else in the world, and that, though personnel salaries are double or treble, productivity is five or six times higher. Hence minimum utilization of aircraft can be lower, and there are even airlines there, such as Eastern Air Lines, which make a profit if they "sell" only 50% of their aircraft capacity. Yet, since 1953, not even this most prosperous of all commercial aviation systems has succeeded in balancing revenue and expenditure. True, the U.S. air transport industry is developing at a healthy rate, but expenses are growing faster than receipts. There remains the possibility of increasing rates. Earl D. Johnson, President of the Air Transport Association of America has pointed out that the price of seats in commercial aviation has increased by only 5% since 1938, whereas rail and road have had to raise their rates by 27% and 34% respectively. However, the Administration does not plan to increase fares except as a last resort.

[1] "American Aviation," January 13th, 1954.

Africa represents a "bill of exchange on the future" for French air transport. – Arrival of the Air France mail aircraft at an airport in French West Africa.



DEVELOPMENT OF ACTUAL LOAD FACTOR COMPARED WITH BREAK-EVEN LOAD FACTOR
Since 1951 load factor in passenger transport (percentage of seats occupied in relation to number offered) has steadily fallen.

—— actual load factor
------- break-even load factor

Airlines, meanwhile, are struggling by all the means in their power to escape the rising spiral of expenditure and revenue without recourse to higher fares. T.W.A., for example, has reduced staff costs, by increasing average productivity from 10,674 to 11,864 ton-miles during the first six months of 1954. Flights have also been speeded up, both in the air by using the maximum cruising speed, and on the ground by new maintenance procedures. In the purely commercial field, first tourist-class services and then the "pay later" scheme have been introduced to expand the market. Between May 1st and July 15th, 1954 Pan American recorded receipts of $900,000 from the sale of tickets on credit. Other partial solutions are also being examined, such as abolition of reduced family rates, penalties for cancelled reservations, or increase in the difference between first and tourist class rates. In fact, U.S. air transport, having exhausted all the technical expedients now available and tried out practically all the commercial "tricks", is suffering from the same sickness as world air transport in general: *the progressive stabilization of the market.*

European problems

Geography, economics and politics combine to make the task of European carriers more complex. They are forced to base their activity on an intercontinental network on which their aircraft operate long distances at low frequencies. For this reason the mean productivity of their staff cannot be more than a quarter or at best a half of that of U.S. airlines, with their very much higher traffic volume. It follows that, as a general rule, U.S. airlines can accept a very much lower load factor than

In 1954 Indo-China still accounted for almost 40 % of French long-distance traffic. Here the Air France premises in Saigon.

Air carriage of French wounded during the fighting in Indo-China (Transports Aériens Intercontinentaux).

is possible in Europe where a "ton" of air traffic sells at a much higher price. Flying equipment, generally more varied in type, also adds to the European airlines' financial burdens. In 1953 American Airlines, for example, had 188 aircraft which produced more than 3,000,000,000 passenger-miles, but this fleet comprised only three basic aircraft types. Similarly, Eastern Air Lines produced more than 2,500,000,000 passenger-miles with 111 aircraft of four different types. On the other hand, B.O.A.C.'s figures were 930,000,000 passenger-miles produced by about 60 aircraft of six different models. Standardization of European commercial air fleets is not yet in sight, since quite a number of obsolescent aircraft are still in use because of the difficulty of deciding on an equipment policy that would reconcile strict operating economy and the needs of national aircraft industries.

Seasonal traffic variations are very much greater in Europe than in the United States. The difference between "peak" months and "off" months in America is about 30%, while in Europe the percentage is 250 or even 275 on the heavily travelled routes. Airlines here naturally have some difficulty in organizing their services in view of the influx of tourists in the summer and a much greater utilization of ground transport in the winter than is the case in America.

Air transport economists have tried to compare the economic region of Western Europe and the Mediterranean basin to the United States. The former region has a population of 300,000,000, of whom nearly 60,000,000 live in towns of more than 250,000 inhabitants; the latter 165,000,000, of which about 40,000,000 are grouped in 38 towns of more than 250,000 inhabitants. The European region has the greater population and more large towns, but is greatly inferior in total income and in mean income per head of population, with figures equivalent to a half in the first case and a quarter in the second. The economic and demographic distribution still further accentuates the differences. Three quarters of European economic activity is concentrated in an area roughly 600 miles square in the Northwest of the continent; whereas in the United States the regions of intense economic activity are dispersed around the perimeter of Federal territory. It follows that distances between urban centres are much smaller in Europe than in America. And the age of ground transport has left much greater traces in Europe than in America, where air transport has thus benefited from natural conditions that do not exist in Europe. By and large each million of America's 165,000,000 population provides 46,000 customers for commercial aviation, compared with less than a tenth of this figure for each million inhabitants in the European region. Such is the economic and geographical background. On top of this comes the political mosaic of Europe, with its still greater complications.

Example of a rationalized air fleet: American Airlines, whose 188 aircraft produced more than 3,000,000,000 passenger-miles in 1953, has only three basic types: DC-6, DC-7 and Convair Liner.

*

The Sforza plan for the unification of civil aviation in Europe was presented to the European Council of Ministers in Strasbourg, and I.C.A.O. was invited to organize a conference to examine Europe's special problems. But it is obvious today that no supranational organization and no integration of national resources will supersede, for some considerable time to come, the present system of national airlines. The only hope of simplifying somewhat the workings of a complicated machinery, badly adapted to its market, is by "facilitation" measures. National airlines, financially supported by their individual governments, will seek a solution to their difficulties in increasingly keen competition and increasingly high state subsidies.

Is the anxiety shown by the air transport experts justified?

Will the *Super Constellation*, the Douglas DC-7 and the *Viscount* reduce the load factor required to balance expenditure? Despite the high investment needed, it will probably be the introduction of larger numbers of aircraft of greater economic performance that will increase the profit margin. The means of improving the economy of air transport, in Europe and more generally in other parts of the world, lie in rationalization of fleets, the coordination of competing airlines and the improvement of productivity.

The Engines for Tomorrow's Airliners

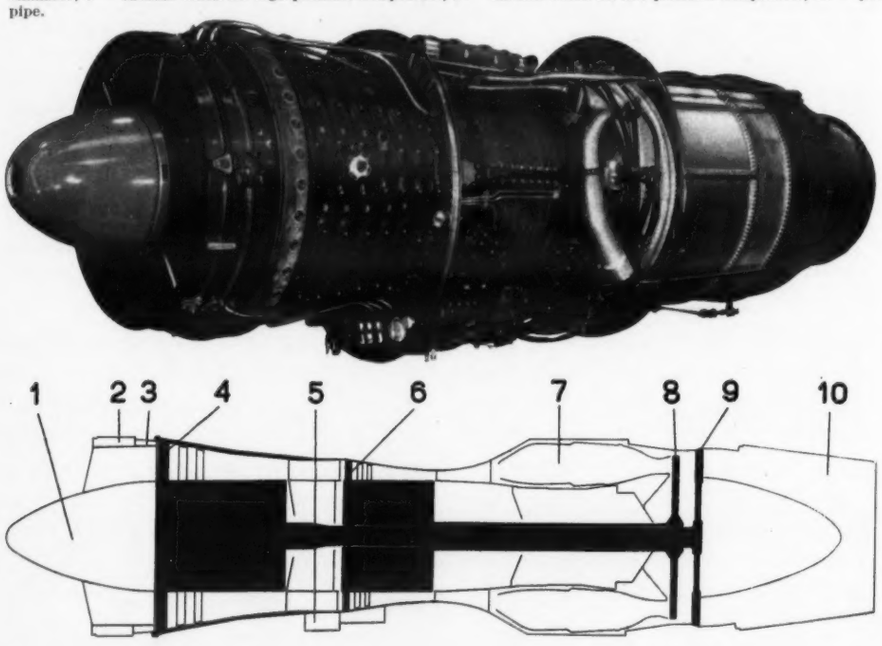
A REVIEW

In its October 1954 issue **Interavia** reported on turbine-powered aircraft on both sides of the Atlantic. The review covered not only the existing prototypes and production models of jet and propeller turbine aircraft, but also their power plants and a number of more recent, still unproven engines. It was seen that gas turbine development was still in a fluid state, so that it is not possible to forecast how the **four main categories**—turbojets, by-pass engines, propeller turbines and compound engines—will be spread over the speed and range field in air transport. In particular, it was shown that no assessment can yet be made of what medium-powered turboprops will be adopted in commercial operations or when.

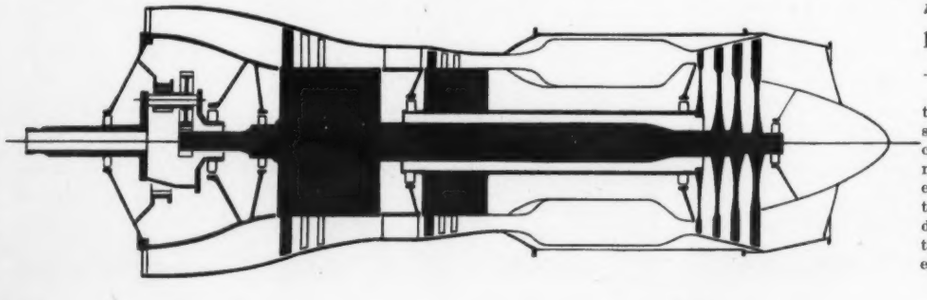
The past six months have brought little change in this situation. However, more up-to-date information on the possible British, French and American air transport contenders in the field of turbine engines has since become available, so that the previous review can now be supplemented.

Pratt & Whitney J-57 two-spool turbojet (10,000 lbs. static thrust) in final assembly at East Hartford, Connecticut.

General view and section of the Bristol *Olympus* two-spool turbojet for 11,000 lbs. static thrust: 1 – 22.5 kW generator in nose; 2 – annular oil tank; 3 – hot air de-icing manifold; 4 – six-stage low-pressure compressor; 5 – fuel pump and other accessories; 6 – seven-stage high-pressure compressor (with bleeds); 7 – cannular combustion chamber; 8 – turbine wheel for high-pressure compressor; 9 – turbine wheel for low-pressure compressor; 10 – jet pipe.



Derived from the *Olympus* . . . the Bristol BE. 25 two-spool propeller turbine, which is quoted as having a constant power of approx. 4,250 e.h.p. from sea level to 17,500 ft.



I: Turbojets

With the grounding of the de Havilland *Comet 1,* the only radial-compressor turbojet (D.H. *Ghost*) so far used in air transport has disappeared from the picture. The modified, structurally reinforced successors to the *Comet 1* are to have axial-compressor engines (R.-R. *Avon*). On the other hand, America's Boeing 707 *Stratoliner/Stratotanker* jet commercial transport was fitted from the outset with super-powerful two-spool (double-compressor) engines for axial air flow (P. & W. J-57s).

It may now be said with reasonable certainty that all future turbojets for airline operations will be of the axial flow variety, not so much because of their smaller frontal area, compared with the radial configuration, but because of their very much lower fuel consumption per pound thrust and hour. *This specific consumption, a basic problem in the design of every jet aircraft, depends on the one hand on the propulsive efficiency and on the other on the thermodynamic efficiency*[1] *of the engine.* Whereas, however, it is scarcely possible to increase further the propulsive

[1] The propulsive efficiency is the ratio of the actual thrust work per second (thrust in flight times aircraft speed) to the mechanical work per second required to create this thrust (difference in kinetic energy of the air mass flow). In turbojet engines the propulsive efficiency equals $2v/(c+v)$, when v is the aircraft speed and c the mean exhaust velocity from the jet pipe. – Thermodynamic efficiency indicates the degree of utilization of the energy (chemical energy expended to mechanical energy released).

efficiency in single-shaft pure jet engines for subsonic flight, designers still succeed in raising the thermodynamic efficiency. *These results are attributable primarily to the multi-stage compressors for high compression ratios, which can only be used in axial designs.*

The compression ratios in high-performance pure jets are already very high and will probably be still further increased in the future. The Bristol *Olympus* (11,000 lbs. static thrust), with two axial compressors and two independent turbine wheels (see picture), for example, has a compression ratio of 11:1 and attains the very low specific consumption of 0.79 lbs./lbt.hr. The manufacturers have also announced plans to raise the compression ratio still further, to 16:1 (comparative value for D.H. *Ghost 50* 4.7:1).

The American *Pratt & Whitney J-57* turbojet (10,000 lbs. thrust) — power plant for the Boeing 707 transport, the Boeing B-52 strategic bomber and a number of U.S. Air Force and U.S. Navy heavy fighters—also has two independent axial compressors. The low-pressure compressor is driven by a two-stage turbine, and the high-pressure compressor by a single turbine wheel. Specific consumption is also said to be extremely low (no figures available), so that this engine was the obvious choice for America's first jet commercial transport, the Boeing 707.

The following is a survey of more recent turbojets, with their sea level static thrust without afterburning or water injection:

Great Britain

Bristol **Orpheus**	4,850 lbs.
Rolls-Royce **Avon RA.16**	9,000 lbs.
Armstrong Siddeley **Sapphire 7**	10,200 lbs.
Bristol **Olympus**	11,000 lbs.
de Havilland **Gyron**	approx. 16,000 lbs.

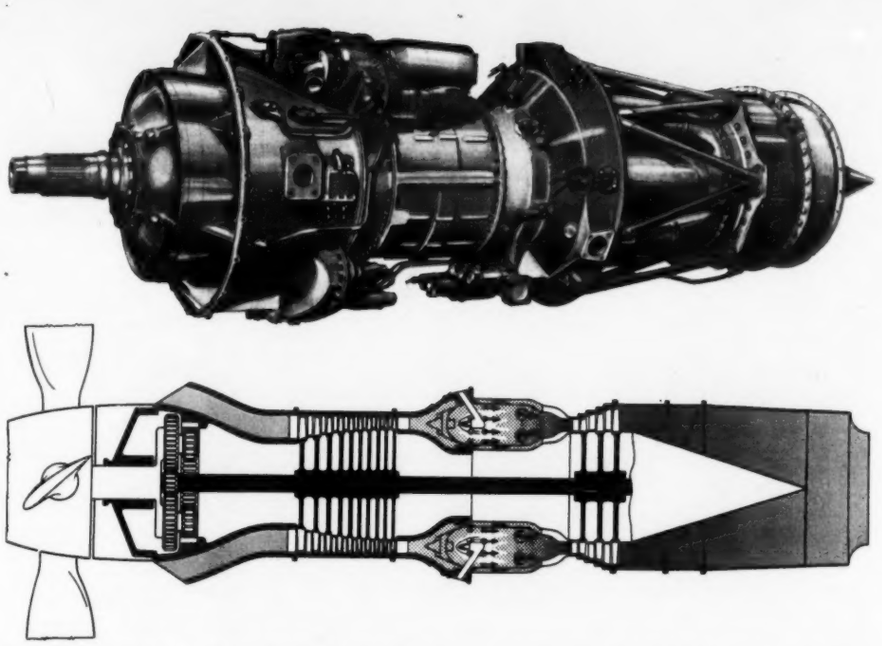
France

SNECMA **Atar 101 E**	7,700 lbs.
SNECMA **Vulcain**	approx. 13,200 lbs.

United States

Pratt & Whitney J-57	10,000 lbs.
Curtiss-Wright J-65 **(Sapphire)**	approx. 7,200 lbs.
Curtiss-Wright J-67 **(Olympus)**	approx. 11,000 lbs.
Allison J-71	9,700 lbs.
General Electric J-73 (ex J-47)	9,200 lbs.
Pratt & Whitney J-75	15,000 lbs.

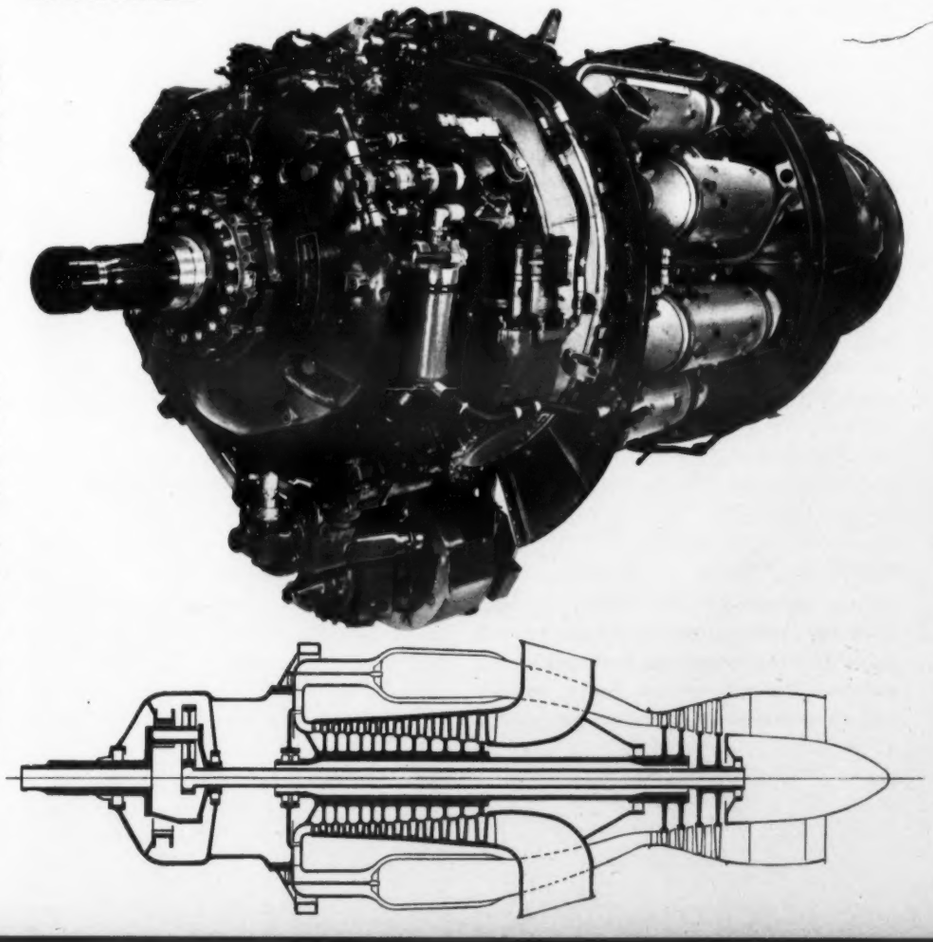
One drawback is that double-compressor engines are considerably more costly to purchase and maintain than single-compressor engines. A single production J-57, for example, is said to cost $250,000. It is therefore doubtful whether air transport can afford many such "super engines". However, there are also certain single-spool engines, such as the *Rolls-Royce Avon RA.16* (9,000 lbs. thrust), *Armstrong Siddeley Sapphire 7* (10,200 lbs.) *Curtiss-Wright J-65* (licence version of the *Sapphire*), which have relatively low fuel consumptions (0.85 to 0.885 lbs./lbt. hr). This would appear to recommend them for air transport.

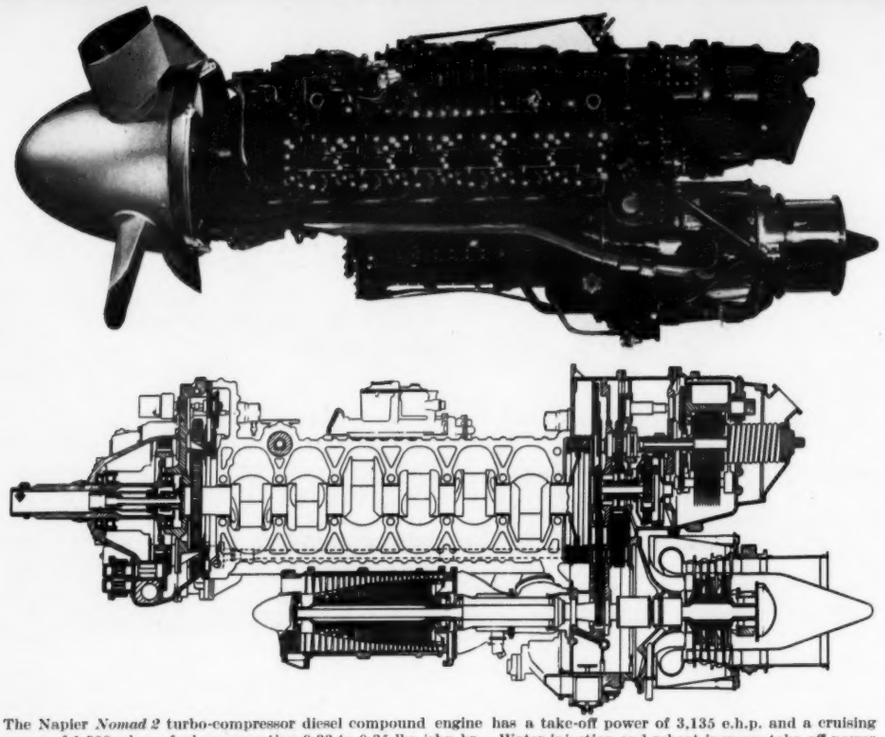


The Napier *Eland* single-shaft propeller turbine (ten-stage compressor, six combustion chambers, three-stage turbine, reduction gear) now delivers 3,000 e.h.p. (at 12,500 r.p.m.) but is being developed for a take-off power of up to 4,000 e.h.p.; fuel consumption 0.62 to 0.69 lbs./e.h.p. hr.

At the lower end of the power scale the *Bristol Orpheus* (4,850 lbs.) single-shaft axial-compressor jet calls for notice, though it is not yet operationally proven. As this engine may perhaps be built in some quantity for the N.A.T.O. "pocket combat aircraft" programme, it might also come into consideration

The Bristol *Proteus 755* two-shaft propeller turbine (twelve-stage compressor; eight combustion chambers; two independent two-stage turbines; reduction gear) delivers about 4,150 e.h.p. (at approx. 12,000 r.p.m.); fuel consumption 0.49 to 0.7 lbs./ehp.hr.





The Napier *Nomad 2* turbo-compressor diesel compound engine has a take-off power of 3,135 e.h.p. and a cruising power of 1,900 e.h.p.; fuel consumption 0.33 to 0.35 lbs./ehp.hr. – Water injection and reheat increase take-off power to 4,100 e.h.p.

—provided, of course, it proves sufficiently reliable and has a low enough consumption—for a future medium-stage commercial transport.

II: By-pass engines

In the battle against the jet engine's "thirst", designers have long been on the look-out for means of improving not only the utilization of thermal energy but also the present *unsatisfactory propulsive efficiency in subsonic flight*. The propulsive efficiency improves as the exhaust velocity diminishes in relation to the aircraft's speed. In the most favourable case, which, however, is not obtainable in practice (exhaust velocity equals aircraft speed) this efficiency would be one. As the speed of subsonic aircraft is determined by the airframe's critical Mach number, the only way out is to reduce the mean exhaust velocity of the gases.

One way of doing this is to add to the hot gases behind the turbine additional cold air, fed direct to the jet pipe by a low-pressure compressor *in front* of the main compressor, by-passing the combustion chamber and turbine. This *second* circuit in the by-pass or ducted fan engine increases the air mass flow and at the same time reduces the mean exhaust velocity. A welcome by-product of the latter is a reduction in noise.

The forthcoming competition between single-shaft pure jets and by-pass engines will doubtless be a gripping one. Both military—in particular M.A.T.S. General Joseph Smith—and commercial aviation experts are already calling for a speed-up in the development of by-pass engines. At the moment, however, there appears to be only one under development, the *Rolls-Royce Conway, of 15,000 lbs. static thrust*.

III: Propeller turbine engines

In the general view of the experts, there is room for considerable improvement in the general and detailed design of the propeller turbine, which has hitherto been relatively neglected.

In addition to the use of multi-stage compressors for *high compression ratio*, designers appear to be aiming at an increase in working temperatures. In particular, the introduction of *reheat between the turbine stages* could both improve performance and reduce consumption. Side by side with the structurally simple single-shaft engines (e.g. Napier *Eland*, see section drawing) there are a number of two-shaft engines, most of them with independent, multi-stage turbine wheel to drive the inner propeller gear shaft, as for example in the Bristol *Proteus* (see section drawing).

The *Bristol BE.25*, latest two-shaft engine, still under development, which is a kind of cross between the *Olympus* turbojet and the *Proteus* turboprop, has *two compressors*, so that the propeller gear drive had to be coupled to the (forward) low-pressure compressor (see section drawing). Described as a constant-power turboprop, the BE.25 is designed for a power of approx. 4,250 e.h.p. up to 17,500 ft. Not until above this altitude does power begin to diminish roughly linearly; at 35,000 ft. it is still about 3,300 e.h.p. The advantages of this design and regulation method are clear: unrestricted take-off ability at all airports, regardless of climate or altitude; excellent climb performance to cruising altitude; reduced structural weight, since the gear need be dimensioned only for a maximum of 4,000 s.h.p.

The following is a survey of more recent propeller turbines, with details of their max. equivalent horse power:

Great Britain

Rolls-Royce **Dart 6**	1,550 e.h.p.
Rolls-Royce **Dart** development	approx. 2,000 e.h.p.
Napier **Eland**	3,000 e.h.p.
Napier **Eland** development	approx. 4,000 e.h.p.
Bristol **Proteus 755**	approx. 4,150 e.h.p.
Bristol BE.25	approx. 4,250 e.h.p.
Rolls-Royce RB.109	approx. 5,200 e.h.p.

France

Turboméca (project)	approx. 4,000 e.h.p.

United States

Pratt & Whitney T-34	approx. 6,000 e.h.p.
Allison T-38	2,960 e.h.p.
Allison (2×T-38) T-40	5,500 e.h.p.
Wright T-47/49	approx. 10,000 e.h.p.
Pratt & Whitney T-48/52	approx. 8,600 e.h.p.
Allison (2×T-56) T-54	approx. 7,600 e.h.p.
Allison T-56	approx. 3,800 e.h.p.
Pratt & Whitney T-57	approx. 15,000 e.h.p.

IV: Turbo-compound engines

From the point of view of fuel economy, compound engines—i.e., a combination of gas turbines, piston engines and in some cases turbo-compressors—undoubtedly provide the best solution. Engines of this kind are made by *Curtiss-Wright* in the United States (*Turbo-Cyclone 18* of up to 3,700 h.p.) and by *Napier* in Great Britain (*Nomad 2* of 3,135 h.p. without water injection).

The *American* engine is in principle an 18-cylinder two-row radial, which expands its exhaust gases in three exhaust turbines mechanically coupled to the crankshaft; it works on high-octane aviation gasoline. The *British* engine—a 12-cylinder two-stroke diesel engine with an exhaust-driven turbine and multistage axial-compressor supercharger—runs on kerosene or diesel oil. The extremely low fuel consumptions of the two compound engines:

Wright Turbo-Cyclone 18 (at 50% rated power)	0.39 lbs./h.p.hr.
Napier Nomad 2 (at 3,135 h.p.)	0.33 lbs./h.p.hr.

would make them of interest for medium speed ranges in air transport.

Back to Luxury

One year ago the scheduled airlines of the United States were wondering, with good reason, if they were viewing a "handwriting on the wall" in the trend of European carriers toward no-frills, minimum-cost coach service.

They had accepted as an annual recurrence a winter decline in business.

But something was wrong. The expected "flare-out" from their economic dive hadn't come. Payloads were dropping, payrolls were rising, and airline presidents in some instances faced the unhappy prospect of telling their stockholders: "Sorry! There will be no dividends this time!"

In sharp contrast, the nation's non-scheduled independent air coach operators were having a field day. In newspaper advertising broadsides, on billboards, and by radio and television they shouted cut-rate fares, boasted accident-free operations when they could, boldly promised everything but the ability to get the cash customer on his way when he wanted to go or to deliver him and his sardine-packed fellow travelers on time.

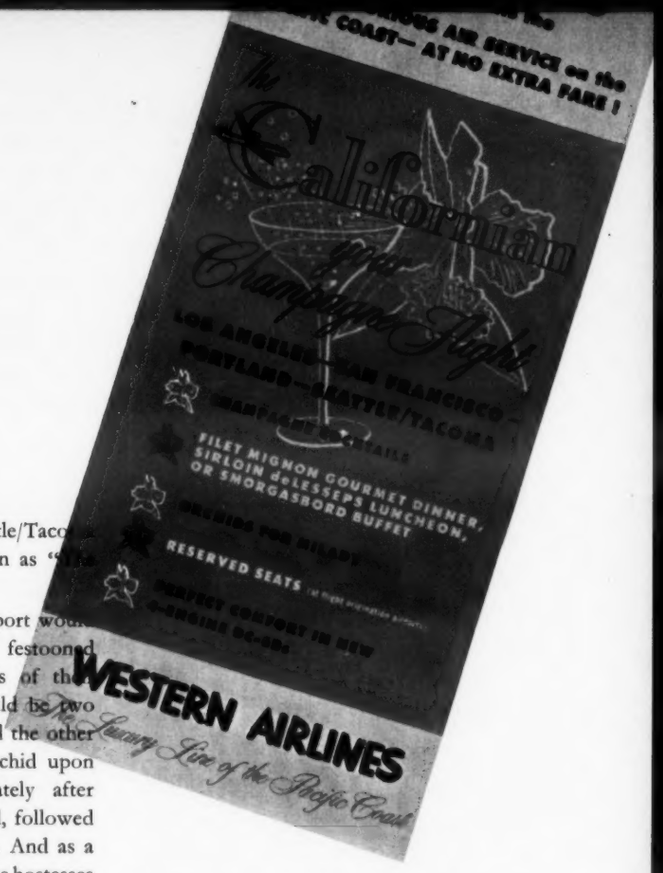
In defensive desperation U.S. scheduled airlines increased their coach services; adding seats, dropping in-flight meals, lowering fares to approach but not quite meet those of the cut-rate non-scheduled lines.

That they didn't succumb wholly to predictions of many of their crystal ball economists, and immediately transform U.S. air travel into a motor bus service with wings, may be attributed to two interesting developments of mid-1954:

The first-class air travel nosedive showed signs of leveling off near the end of the first half of the year, at least sufficiently to forestall a financial crash landing.

And on the West Coast a major regional airline let the word get around that it intended to give its first-class customers the most luxurious treatment they had ever received. Western Air Lines announced that on June 1st it would inaugurate between Los Angeles, San Francisco, Portland and Seattle/Tacoma a new DC-6B service to be known as "The Californian".

Passengers checking in at the airport would select from a cabin-outline chart festooned with seat-numbered tags the seats of their choice. At the cabin entrance would be two air hostesses, one to take wraps and the other to pin a fresh Hawaiian Vanda orchid upon each woman passenger. Immediately after takeoff champagne would be served, followed by full-course filet mignon dinners. And as a parting gesture after landing one of the hostesses would be at the cabin door with an open humidor of cigars for the male passengers. All of it "on the house", without a penny added to the first-class fare.



"Back to Luxury" – W.A.L. advertises its "champagne flights".

An orchid. Not a large one – but it has just been flown in from Hawaii, especially for her . . .

Next, the champagne is served.

Had Western's normally astute president, Terrell C. Drinkwater, completely flipped? Champagne for a nation of Martini and highball drinkers!

The stewardesses would see to it that the champagne glasses were kept filled. Dinner trays would be covered with linen. There would be no shredded lobster in the seafood cocktail—large, tempting chunks. The size of the filet mignon would be increased one ounce. Cabins of "The Californian" would be walled expensively with cowhide—70 hides per plane.

For a scheduled carrier trapped with others in a rather frightening aircoach-or-bust depression, Western's behavior was, to say the least, peculiar. But so were the results!

Exactly seventeen days after inaugurating the champagne-and-orchids service Western announced the doubling of its "Californian" flights and has since expanded the operation to San Diego, Salt Lake City and Minneapolis–St. Paul.

By mid-winter U.S. airline officials were ready to concede that Mr. Drinkwater had not "flipped", and there was a suspicion that a few wished that they had been half as crazy as he had seemed to be when he first talked of champagne, orchids, cigars and filet mignon.

"Good-bye, now!" The cigar (this client seems to have helped himself to two!) is Western's final "Come again!".

Present passenger traffic aboard Western Air Lines flights shows a 70-30 ratio in favor of our deluxe service over our economy aircoach schedules.

While we plan to continue development of our "red-carpet" service—for example, the champagne-and-orchids "Californian" flights—we believe the substantial aircoach market will continue to grow in proportion to expected increases in the popularity of deluxe schedules.

Operating as western America's major regional trunkline, we can speak only for the area we serve, realizing that economic and growth factors in other regions may prove substantially different from those of the Far West in the next few years.

In the 12 western states and Canada, however, we feel confident that the trend will continue along the 70-30 traffic ratio.

* The fact that Mr. Drinkwater is the air transport industry's "champagne" protagonist is, we believe, pure coincidence. - Ed. -

Terrell C. Drinkwater*
President, Western Air Lines

Reports Arthur F. Kelly, W.A.L. vice-president in charge of sales: "Last September, October and November we should have experienced a seasonal dip in passenger revenues. Instead, they went up ten to fifteen percent. People who previously have been staying on the ground during winter months have been riding our 'Californian' flights during January and February."

Marvin W. Landes, Western's vice-president in charge of passenger services, believes that the champagne-and-orchids deal has stemmed a U.S. rush for the air coaches, and has outlined a new pattern for passenger sales among American carriers. A major East Coast airline, noted for years for its high-density, no-frills coach service, has since made a detailed study of the "Californian" service, and soon may announce a similar plush service on its routes.

It is quite possible that Western has touched the secret of bolstering an ailing passenger market—the creation of a novelty to delight the imagination of air travelers who have grown weary of "the same old thing" in air travel.

In the minds of Western officials was the conviction that domestic passengers would respond with equal enthusiasm to the "red carpet" treatment accorded passengers by the major trans-ocean carriers. Long before the "Californian" was announced, Western's traffic representatives staged a system-wide survey to search out innovations which might be most alluring as a "package deal" to first class travelers.

"Much to our surprise", relates Landes, "we found that on the subject of serving alcoholic beverages only 35 percent of those questioned were interested in being served cocktails. But 95 percent said they would like champagne!"

Considering the returns realized, the financial outlay for the frills of the champagne flights has been hardly more than a drop—in the champagne bucket. The wine is a bulk process California champagne of excellent quality for its type, and quite inexpensive in the quantities ordered by the airline. The orchids are small and also inexpensive, but a delight to their wearers. Cigars are better than average in the low-price bracket.

Aboard a "Californian" flight there is an unusual sense of passenger intimacy and even adventure, and there is hardly a trip that a normally stolid business man does not leave his seat to insist that the air hostess let "an old hand" show her how to cope with an awkward champagne cork.

As with all good things, the temptation is strong to embellish. Were it not that the DC-6Bs are too fast to stay within range of a given TV station for the duration of a one-hour program, the "Californian" flights would be offering television to their passengers this summer. As a substitute, however, the champagne planes are now being wired to fill the cabins with soft, tape-recorded music . . . "Back to Luxury" seems to pay.

Postmaster General von Stephan (1831—1897).

A Nineteenth Century Prophet

by Alfred Heerhartz, Berlin

This summer Deutsche Lufthansa is resuming regular services. West Germany regains her air sovereignty and becomes a full member of the world aviation community.

The development of this world aviation was foreseen 81 years ago by German Postmaster General von Stephan. In other respects, too, his ideas helped to prepare the transition to the twentieth century. For example, the creation of the Universal Postal Union, officially inaugurated in the old Ständehaus in Berne on October 9th, 1874, was due to his initiative.

In a paper entitled "World Posts and Air Navigation" which he read to the Scientific Society in Berlin on January 24th, 1874, and again in an article entitled "Mails by Air" published in 1884, Stephan forecast that "mankind would, in the not-too-distant future, have at its disposal a new, highly important instrument of transport". The dream of the American airship expert John Wise would be fulfilled. "Our children will be able to travel to all the ends of the earth, without being troubled by steam, sparks or seasickness, and at a speed of 20 knots."—"Just as world postal services," continues Stephan, "already fly in thought over the whole globe, they will surely be the first on the spot when it is at last given to mankind to wing freely through immeasurable space from zone to zone, like the migratory birds."

Stephan first goes through the whole range of transport vehicles throughout the ages. He complains that land vehicles are not always of the most comfortable and praises the comforts of steamships . . . "But there is not navigable water everywhere. On the other hand Providence has surrounded the whole globe with navigable air. This great air ocean is still as good as empty and deserted as far as human transportation is concerned. In the same way as we regard the air ocean today, so our forefathers once regarded the seas and contented themselves with bathing, fishing and making salt."

Stephan then discusses the balloon experiments in detail. Instead of the balloon shape he proposes a fish-shaped body, to reduce air resistance. And on the subject of controlling a balloon he writes: "The main problem is to devise a sufficiently powerful propulsive machine of low weight and with no danger of fire. Man will undoubtedly find a way of utilizing for this purpose some such force as electricity, magnetism, heat or the expansibility of gases. Steam engines will not do." He gives the propeller as the means of propulsion and finally even recommends the reaction force of rockets, which should be filled with solid carbon dioxide (!)

Stephan's prophecies have been fulfilled and have confirmed his statement that "Assessing the future depends on knowledge of the past. Prophecy is knowledge."

Some Reflections on The Comet Inquiry

BY JAMES HAY STEVENS, LONDON

The catastrophic nature of the *Comet* accidents early last year and their terrifying suddenness at a time when these airliners appeared to be settled in steady service[1] make it difficult to view the subject with dispassionate objectivity. It is all too easy to slip into criticism and be tempted to apportion blame, rather than to regard the whole affair logically and to sort out cause, effect—and the future.

The vast, meticulous Report by the Royal Aircraft Establishment at Farnborough (still not available for detailed examination), the protracted Inquiry with its immense verbiage[2] and, in particular, the quasi-legal nature of the Inquiry add to the difficulties of the writer who tries to be objective. It also gives him sympathy for the members of the Court of Inquiry who had to study the 110,000 word Report together with 144 other exhibits, the statements of 68 witnesses and over 800,000 words in the transcript of the proceedings. It is small wonder that the results, and even the interim findings, expected by Christmas time, were so long delayed.

It was obvious to the onlooker that it was most likely that the results of the R.A.E. investigations would be substantially confirmed. The R.A.E. programme was so exhaustive, from the reconstruction of the pieces of G-ALYP salvaged off Elba by the Royal Navy, to the ground and flight testing of the various airframes, that it was manifestly done on an *ad hoc* basis and not just so as to prove the pressurization-fatigue theory of Sir Arnold Hall, Director of the R.A.E. at Farnborough.

By a process of elimination, the *Ghost* turbojets, fuel explosion, overstressing of the wing due to excessive refuelling pressure, overloading by weather or by misuse of the power controls and jet-noise damage were ruled out, or at least reduced to bare possibilities.

The fuselage wreckage revealed evidence of catastrophically explosive decompression akin to that of pressure cabin test pieces that failed before the practice of submerged testing was established. The injuries to the passengers, plus model tests provided *graphic* supporting evidence of explosive decompression at high speed. After it had been ascertained that the disruption of the fuselage was the first step in the break-up and ignition of the aeroplane, there came the "detective work" to find the initial cause.

In this connection it is important to note that it was *after* the bursting of the fatigue-test fuselage of G-ALYU and the revelation of damage in the first pieces of wreckage recovered suggesting catastrophic decompression that the search off Elba was re-orientated—and the vital fragments were recovered.

It is at this point where some disagreement, or at least doubt, becomes manifest. The R.A.E. carried out two sets of tank tests, with pressurization and simulated flight loads, that led to fuselage failures at 9,000 "hours" (3,060 pressure reversals) and 17,000 "hours" (5,546 pressure reversals). These failures started at the corners of the rectangular window frames and were akin to those in the very similar ADF openings where the initial fractures occured on the Elba *Comet*. Metal fatigue was visible at the cracks, near the edges of the skin. From strain gauge analysis and by extrapolation the R.A.E. team, under Dr. P. B. Walker, concluded that when pressurized to the normal value of 8¼ p.s.i. the metal at the edge of the frame is subjected to as much as 70% of the ultimate stress of the material (DTD 546)—but if this is so, how was it that the frames withstood double pressure under static test? During the Inquiry de Havilland engineers contested this figure of 70% of the ultimate stress, saying that the extrapolation was fallible. Sir Arnold Hall explained that failure under "high level" fatigue, while withstanding a phenomenally high static stress, could be explained by plastic flow in the metal near the openings which could relieve the local load concentration under a single very high stress.

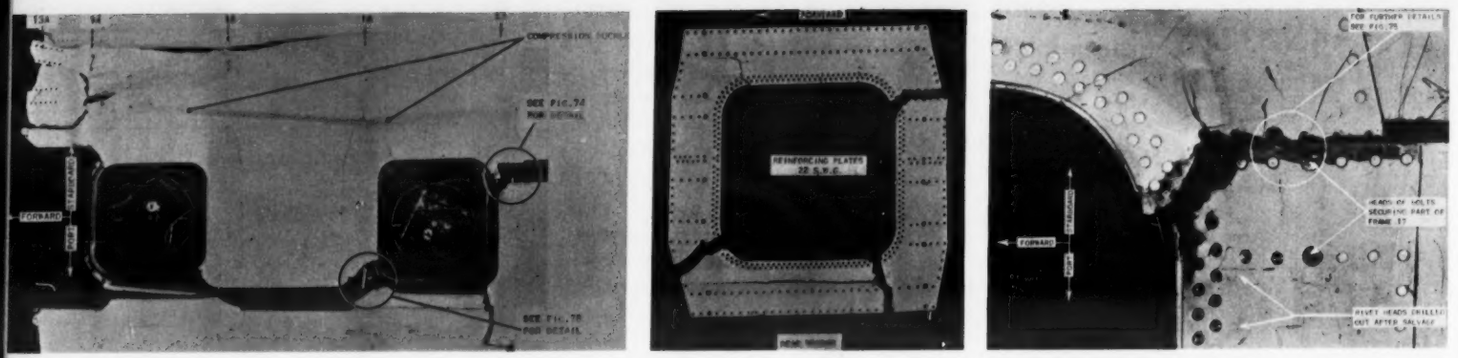
Manufacturing errors and cracks were discovered near the openings, and their effect upon the strength was the subject of debate, although the discovered faults did not appear to have a bearing on the Elba accident or the fatigue tank failures. The Court further considered that the action of the manufacturers regarding these cracks was perfectly consistent with current practice. Nevertheless, one feels that in future it would be wise to adopt specially rigorous manufacturing standards upon all high-differential cabins.

The whole question of *fatigue failures* was debated at length, with particular reference

The fuselage of *Comet* G-ALYU was "artificially fatigued" to destruction in the R.A.E. water tank at Farnborough. The latter is 112 ft. long and has a capacity of 200,000 gallons of water. Both the maximum cabin pressure and the safe air load on the wings were simulated in rapid reversals, each five-minute test being equivalent to three hours of flight. (All pictures *British Crown Copyright.*)

[1] During the Inquiry B.O.A.C. Operations Director Sir Victor Tait said the B.O.A.C. *Comets* had flown 25,408 hours up to the Naples crash, or about 10 million miles.

[2] Summarized in the official Report of the Court of Inquiry (48 pages and numerous illustrations) issued by the Ministry of Transport and Civil Aviation: *C.A.P. 127*, Her Majesty's Stationery Office, 1955. – Price 8 shillings.



Fatigue ruptures at the cut-outs for ADF aerials started the break-up of G-ALYP off Elba: *Centre:* the decisive piece of evidence of the primary cause of the G-ALYP accident, after its recovery from the Tyrrhenian Sea. Fatigue failures occurred at the corners of the critical reinforcing plates. *Right:* detail of the rear corner of the second ADF aerial window in G-ALYP: the rupture here was followed by a sudden split in the skin along the fuselage centre line.

to "scatter", and the reasoning is somewhat abstruse. Structural scientists regarded the tank test fuselage as a cylinder with eighteen identical fatigue specimens (the windows), of which one failed at 9,000 "hours", and another at 17,000 "hours", while sixteen were left intact. This suggests an *average* fatigue life nearer 17,000 than 9,000 "hours". That is, the danger period would start after 5,000, not 3,000 actual flying hours.

The Elba *Comet* (G-ALYP) had actually flown 3,495 hours: the test specimen (G-ALYU) had reached 1,230 pressure reversals in the air and 1,830 on test, totalling 9,000 "hours": while the Naples *Comet* (G-ALYY) had only flown 2,704 hours—say 900 pressurizations. These are the facts that some engineers, including Mr. Walter Tye, Chief Technical Officer of the Registration Board, find it hard to reconcile —although structural physicists maintain that such wide scatter is commensurate with our present very limited knowledge of fatigue phenomena.

Given pressurization fatigue as the sole cause of the catastrophe, then a thicker fuselage skin with circular or oval windows is a relatively simple solution on those Comets not yet finished. The others (the remaining Mark 1s of B.O.A.C., Air France, U.A.T. and the R.C.A.F., together with the half-dozen complete, or nearly complete, Mark 2s) might well be rendered safe for a considerable life by a reduction of cabin pressure to, say, 6 ½ p.s.i. which has a very salutory effect on the S/n curve[3]. Alternatively, the areas of stress concentration—window, door, cockpit and wing cut-outs—could be re-inforced by simple external doubler plates.

Such strengthening of the fuselage will, of course, incur a weight penalty, which can be ill afforded by any jet airliner with its high fuel consumption. On the *Comet 2,* for instance, an increase of skin gauge alone might account for about one thousand pounds, on the longer *Comet 3* it may well be of the order of fifteen hundred pounds.

The general investigation revealed the possibility of fuel vapour venting into the wing near the jet pipes; structural damage due to mishandling of the refuelling (it occurred on a R.C.A.F. *Comet*); a wing rib liable to fatigue after some 6,000 hours near the wheel well; and some possibility of localized fuselage skin fatigue aft of the pressure cabin due to jet noise—all straightforward engineering problems easy of solution.

The relatively high break-out forces[5], coupled with low resistance to movement, of the powered control system (which has no feel) was criticised and could, according to Sir Arnold, result in structural failure if a force of some 50 or 55 pounds were used inadvertently to counteract a gust. Criticism, too, rested on the effect of unstrapped pilots, who might jerk the stick, and the need for second-pilot and flight-engineer to change places both during the climb and descent. Mr. R. E. Bishop, the *Comet* designer, said in evidence that on the Mark 3 control break-out force had been reduced.

While the Court ruled out the possibility of the flying controls being concerned in the Elba accident, mention is made of tacit agreement with the findings of the *Indian Court of Inquiry* on the Calcutta accident (G-ALYV; May 1st. 1953)[6] which was that either an exceptional gust or over-control caused the break-up in that

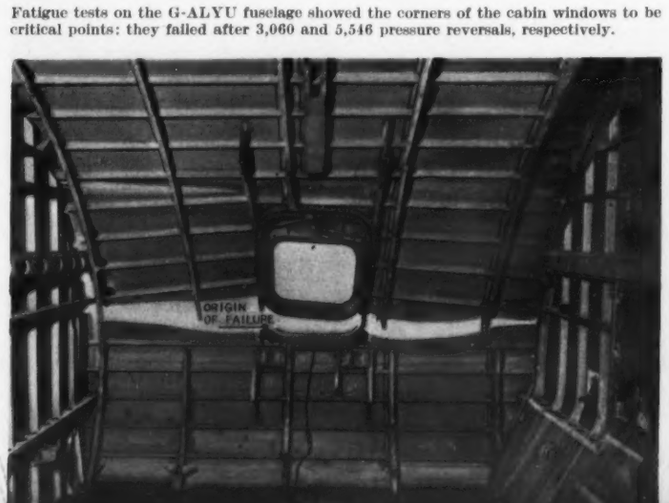
[3] The S/n curve expresses the value of the stress plotted against the number of load reversals. As the number of reversals increases sharply at low stresses, a logarithmic abscissa scale is generally used. In the *Comet 1,* where a 8 ¼ p.s.i. differential gave 70 % ultimate stress locally, a reduction of approx. 20 % in pressure differential would considerably prolong fatigue life.

[4] De Havilland, in a preliminary note, has stated that the skin and other modifications (including strengthening) will add 1,150 lbs. against which 550 lbs. from a rigorous weight-saving programme can be set. Uprating of the Rolls-Royce Avons from 7,050 to 7,350 lb. s.t. permits an extra take-off gross weight. The nett result is a maximum reduction of payload of 440 lb. where all-up weight is the limiting factor.

[5] As in pushing a car, the initial (break-out) force required to move the controls is considerably greater than the resistance encountered once they have begun to move. The break-out forces in the *Comet* seem to have been made relatively high in order to obtain stick-free stability. The danger is that the initial force might over-control the aircraft.

[6] Cf. *Interavia* No. 8, 1953, pp. 411 – 412.

Fatigue tests on the G-ALYU fuselage showed the corners of the cabin windows to be critical points: they failed after 3,060 and 5,546 pressure reversals, respectively.



In G-ALYU too, window frame failures led to sudden tearing of the fuselage skin, first in the longitudinal direction, followed by secondary ruptures in the transverse direction.

case. The Court suggested that the ultimate static strength of the *Comet* fuselage should be established by test.

An important technical feature of the Inquiry was the revelation of the unrepresentative and misleading results that can arise from test specimens. A *Comet* front fuselage full-scale test piece actually withstood pressurization reversals equivalent to 54,000 hours.

DTD 546, the dural-type alloy used for the skin, has an ultimate strength of about 65,000 p.s.i., and the R.A.E., after strain-gauging the suspect window-frames and extrapolating the stress concentrations near the corners, arrived at peak estimates of 43,000 p.s.i. when the cabin was inflated to its normal 8¼ p.s.i. Yet the static test specimen of cabin withstood proof loading to double the normal differential which must have created local stresses of 86,000 p.s.i.—30% above the *ultimate* for the material. This has been explained by Sir Arnold as being due to local stress relief from plastic flow of the material above its elastic limit, which proved to be a tragic accident, since it had two misleading results. In the first place, it prevented discovery of the high concentration of stress in the window frames and in the second, the "proof loading" effect enabled the test piece to withstand subsequent repeated loading beyond its normal fatigue life. Tests on windows in panels fitted to pressure boxes also gave good results with pressurization as high as 20 p.s.i.

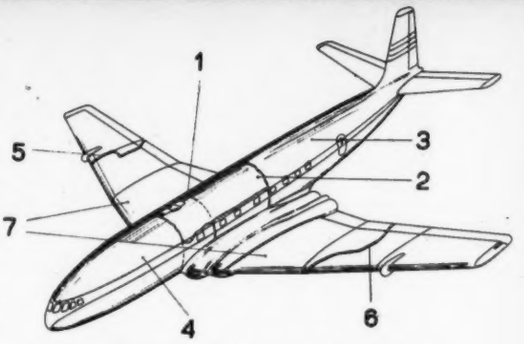
Such partial test specimens are normal practice, and the Court absolves de Havilland from blame for accepting the results[7]. However, it is pointed out that the addition of supporting bulkheads and boxes made the specimens unrepresentative. Since the human mind must always be fallible and it is impossible to be certain of having considered *every* aspect when making a test specimen, the answer is obviously the full-scale tank test for fatigue—just like the now universal full-scale static structural test. It was stated at the Inquiry that even the tank test, with all its elaborate flight-load simulation, omitted engine vibrations and other factors which might well modify the failure of YU from 3,060 "flights" to 2,500 in practice.

The general result of the Comet investigations is that in Great Britain the A.R.B. is tightening up its regulations and requiring high-differential pressure cabin airliners to have two test airframes; one for static test loading and another for repeated pressurization tests. Thus the ultimate factors and the fatigue life will be separately established. The fatigue-life airframe will have its fuselage immersed in a water tank and systems of external jacks will apply a sequence of wing, tail and landing gear loads representing an "average" flight while the fuselage is appropriately inflated and deflated. Pre-service flight testing is to be extended by many hundreds of hours and there will be long and rigorous route testing with VG recorders before any new type will carry passengers.

Already Bristol *Britannia* components are at Farnborough for assembly, after which a new large tank will be built round the fuselage. Vickers-Armstrongs is preparing its own test rig at Weybridge to receive a *Viscount*. Handley Page, as a gesture of faith, is, one understands, going to tank-test a *Herald* airframe in order to establish a true guaranteed life of some 50,000 hours—even though this airliner's low differential virtually precludes cabin fatigue and certainly makes catastrophic disruption impossible.

Dr. A. E. Russell, designer of the *Britannia*, is very confident about his airframe's ability to achieve a fatigue life commensurate with at least ten year's long-range airline operation—30,000 hours. A partial fuselage, some thirty feet in length, has already been subjected to many thousands of pressure reversals. This series of tests weeded out magnesium-alloy as a material for door frames, but proved the rest of the structure. With the R.A.E. tank programme (scheduled for completion about midsummer) Bristol hopes to confirm the validity of the fuselage fatigue life by the middle of this year.

The Vickers *Viscount*, with its lower differential pressure of 6½ p.s.i. and, in particular, the uniform-stress oval window frames and main doors ought to be well in the clear. Nevertheless, in order to be absolutely certain, Mr. George R. Edwards has decided that a test tank should be built at Weybridge and that a *Viscount* airframe shall be tested therein. This action will also serve to allay any possible public suspicion arising from the *Comet* accidents.



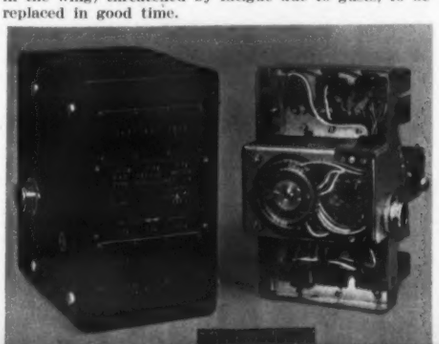
Probable sequence of failures in G-ALYP off Elba: 1 – splits along the top centre line of the fuselage on either side of the ADF aerial windows; 2 – separation of the torn fuselage sections towards the wing tips; 3 – separation of the rear fuselage and tail unit (downwards); 4 – break-away of the front fuselage (downwards); 5 – separation of starboard wing tip between ribs 12 and 13 (downwards); 6 – separation of port wing tip (exact point not known, probably downwards); 7 – wing centre section, together with engines and undercarriage, remained intact until the impact.

Sir Arnold Hall expressed the view, in Court, that the *Comets* could be made safe. As the Director of the R.A.E., Sir Arnold is one of the highest technical authorities in the United Kingdom and his opinion can be taken as fact—in so far as present human knowledge can pronounce on facts aeronautical. *And this brings one to the position of trying to sum up and point the perspective of the picture.*

The *Comet* was the result of intense technical effort in a race to produce the world's first jetliner years ahead of any other manufacturer, and the reactions of passengers, air crews and engineering personnel were favourable to the comfort, handling and maintenance characteristics of the type[8]. The research and test programme that went into the development of the *Comet* was complete; yet through the net slipped several faults—of which one was catastrophic and others very dangerous. This is not, however, a unique position with modern airliners, there have been very serious technical failures on several post-War transport aeroplanes, completely conventional ones at that—engines falling out, fires in flight, disappearances without trace.

The *Comet* had its serious failings, but now it is almost certainly the most completely tested aeroplane in the World. After the R.A.E. investigations it seems inconceivable that anything can have remained undiscovered or unchecked. Only time, however, will prove whether passenger confidence can be restored, or whether it will prove to have a long memory for the accidents and the horror of headlines.

R.A.E. fatigue meter, designed for use in commercial aircraft, will enable any structural parts (particularly in the wing) threatened by fatigue due to gusts, to be replaced in good time.



[7] However the official Report (C.A.P. 127) states on page 26 para. 118: "During the design of the *Comet* de Havillands did not make use of calculations in an attempt to arrive at a close estimate of the stress distribution near the corners of the cabin windows . . . They preferred to rely on tests of specimens designed on the basis of their calculations." – Editors.

[8] Despite the critical take-off angle, which led to the Rome (B.O.A.C.) and Karachi (C.P.A.) accidents, pilots like the *Comet* and approve the handling qualities. Engineers said that the *Comet* had fewer teething troubles than any other airliner they had met.

"CONAD"

Europeans and Americans alike no doubt are more familiar with the efforts the U.S. Air Force is making in building up its Strategic Air Command as an awesome deterrent to any would-be aggressor.

At the same time, however, U.S.A.F. is quietly building up its defensive air strength to protect American cities from possible air attack. Under the present programme, the Air Force is to reach a strength of 137 Wings by 1957, of which 34 Wings—or 102 squadrons—will be allocated to air defence. Half of this defensive strength—about 50 squadrons—is in existence today, composed of about 1,300 first-line jet fighters: North American F-86D *Sabres,* Lockheed F-94C *Starfires,* Northrop F-89D *Scorpions.* All are armed with air-to-air rockets, and most of them are suitable for all-weather use.

To increase the effectiveness of American air defence a special *Continental Air Defense Command* (CONAD) was created on September 1st, 1954, with headquarters at Colorado Springs, Colorado, by the integration of the former U.S.A.F. Air Defense Command, the Army's Anti-Aircraft Command (including guided-missile and radar bases) and the Navy's anti-aircraft establishments. Commander of CONAD is General Benjamin W. Chidlaw, U.S.A.F.; responsible under him for Army and Navy elements, respectively, are Lt. Gen. Stanley R. Mickelsen and Rear Admiral K. Morehouse. Though he will not claim that all bombers of a potential attacking force would be intercepted by the aircraft and missiles of CONAD, Chidlaw nevertheless admits that the U.S. air defences have "made a great deal of progress in the past two years."

Working for CONAD. One of the most important pieces in the Control Room of a Ground Control Intercept Station is the Vertical Plotting Board. Information vital to the "Controller"—the officer who orders the interceptor into the air—is plotted on the transparent board by an airman, while another records the information for future use. The board is in full view of the Controller.

An airman marks the courses of intercepting aircraft on the transparent Vertical Plotting Board of an Air Defense Control Centre. Figures in the boxes show the altitude and track of the aircraft. Individual aircraft positions are telephoned from civilian ground observers via Filter Centres and from radar sites.

The result: – two-and-a-half minutes from the time the "scramble" bell sounds Alert, pilots are airborne in their interceptors. This Lockheed F-94C *Starfire* is streaking out of its alert hangar at New Castle County Airport, Delaware. Of interest is that the fighters start their take-off run directly from the hangars. The huge lifting doors are impressive.

To 3,500 Los Angeles aircraft engineers and executives Bendix Aviation Corporation had sent invitations.

At Ambassador Hotel show, Los Angeles, a sales engineer holds miniaturized component of Bendix PB-20 autopilot. Beneath is the equivalent pre-miniaturization autopilot unit.

End of a Honeymoon?

One should be able to see in the very near future a startling, even encouraging, change in the vitally important accessories segment of the American aircraft industry.

There is evidence that the accessories people, who have long had things pretty much their own way with multi-million dollar orders handed to them on Air Force and Navy silver platters, are about to revert to the shirt-sleeve economy which has enabled the United States to out-produce the rest of the world.

To a considerable extent the Weapon Systems Management programme, making airframe prime contractors responsible for the decision of whose products will be purchased for their airplanes, and in what form and quantity, has started the ball rolling. Accessories makers are discovering that their "best customers" suddenly are scattered all over the country and that the faces behind the order blanks are cool and skeptical.

Prime contractors a few months ago were taking whatever accessories came their way as "GFE"—Government Furnished Equipment —and re-designing their planes to fit whatever they received. Today these same "Primes" are beginning to insist that the accessories be designed to fit into a given niche in an airplane design which will not be altered one whit until it gets into flight and the 'bugs' begin to appear.

Without doubt the end result will be a thorough housecleaning of accessories stock-shelves, and a flow of brand new designs which will be changing and improving as "manufacturers representatives" are transformed into hard-working salesmen—or are replaced by hard-working salesmen.

Bendix Aviation Corporation is an example of a manufacturing group who are taking these new facts of life to heart, and are out to capture as new "customers" the firms which used to be simply points-of-delivery for their government-bought products.

Five Bendix Eastern divisions recently descended with samples of their latest wares, engineers, sales chiefs, public relations directors and top executives upon the aircraft industry in Los Angeles.

They set up shop in two expensive ballrooms in the Ambassador Hotel, distributed some 3,500 personal invitations to aircraft executives and leading aircraft designers, and spent five dawn-to-midnight days demonstrating and displaying their gadgets, getting them into the hands of engineers for close scrutiny, showing engineering mockups of items still in experimental shops. Engineers who wanted to see particular instruments in action were driven to Lockheed Air Terminal for a flight in Bendix' instrument-crowded "flying showcase" DC-3.

C. A. Wolf, general sales manager of the Eclipse-Pioneer Bendix Division of Teterboro, N. J., who was the instigator of the display, put it this way:

"The honeymoon is over. Those of us who hope to stay in business no longer can expect orders to come fluttering in. We think that from here on we are going to have to sell, and sell aggressively, the things we hope our customers will buy. And if the customer wants it built differently, we're going to have to give him exactly what he wants if it is economically possible to do so."

Bendix, of course, is not alone in such thinking. Others, too, are preparing "road-show" sales displays of the things they make. Sales staffs are in an upheaval of administrative changes and expansion. Advertising campaigns are being planned. New sales branch offices are appearing wherever there is a concentration of aircraft production.

Many accessories manufacturers of the United States are peering beyond their back-yard fences; are setting up foreign sales agencies to court European markets previously ignored.

There is a possibility, of course, that the honeymoon is just beginning!

Gimbal mounts for as many as a dozen gyros can be replaced by this new Bendix "Stable Platform" Gimbal. Still under prototype development, it was represented by a plastic model.

D. M. McGrath, General Manager of Bendix Utica (N.Y.) Division, shows a new fibreglass high-pressure storage bottle, 40 percent lighter than an equivalent steel container. Impressive was Bendix demonstration: charged to more than 3,000 p.s.i., it was dropped from a second-story window to the sidewalk, merely bounced like a basket ball. One air charge will give a Wright J-65 turbojet two starts.

Let's

Let's get aboard a naval aircraft and watch what the pilot sees as he prepares for the tricky landing on an aircraft carrier's heaving deck . . .

The aircraft is a McDonnell F2H-2P, a photographic-reconnaissance version of the *Banshee* twin-jet single-seater fighter. And since we cannot squeeze into the cockpit next to the pilot the *Banshee* is using the forward-firing aerial mapping and reconnaissance camera installed in its nose to record the pilot's visual impressions of the landing. The camera, incidentally, is a Type K-48 with a 24-inch lens and an A-25 filter. Time of exposure is 1/200 of a second, exposure interval is two seconds between each of the eight shots. Film size is 9 by 18 inches.

1
The **Banshee** banks for its approach. Hovering in the background like a guardian angel is a Piasecki HUP-2 rescue helicopter.

2
Continuing to bank in order to align itself with the deck for its final approach, the **Banshee** takes its orders from the Landing Signal Officer standing port-side and aft of the deck of U.S.S. **Essex.**

3
The Landing Signal Officer signals "Roger" as the **Banshee** continues in its shallow bank.

4
"Lift up your left wing and get over—align yourself with the centerline of the deck", the LSO tells the approaching **Banshee** with his paddles.

Land On!

At a speed of about 110 knots during its approach the aircraft banks, levels off, gets a "cut" from the Landing Signals Officer (whereupon the pilot immediately chops his power), engages its hook in an arrester cable and stops.

The figure "9" on the aircraft carrier's desk identifies it as U.S.S. CVA-9, i. e., the 39,800-ton (full load) carrier *Essex* which gave the name to the U.S. Navy's *Essex Class* of aircraft carriers. Her length is 888 feet overall, extreme width 147 feet, draught 30.5 feet. She is powered by turbines delivering 150,000 shaft horsepower and has a speed of 33 knots.

The *Essex* carries 100 aircraft and a complement of 1,650 officers and men.

Let's land on!

5

5

"In the slot", i. e., perfectly aligned with the deck, the **Banshee** levels its wings, gets another "Roger" from the LSO; the pilot now gets ready to cut his engines on signal from the LSO.

6

6

The LSO, in the lower left-hand corner, gives the **Banshee** his "cut" order as the aircraft comes in over the aft end of the **Essex'** deck. Ahead of the aircraft are the arrester cables stretched across the deck, further forward is the nylon crash net and, beyond it, there are parked aircraft with their wings folded.

7

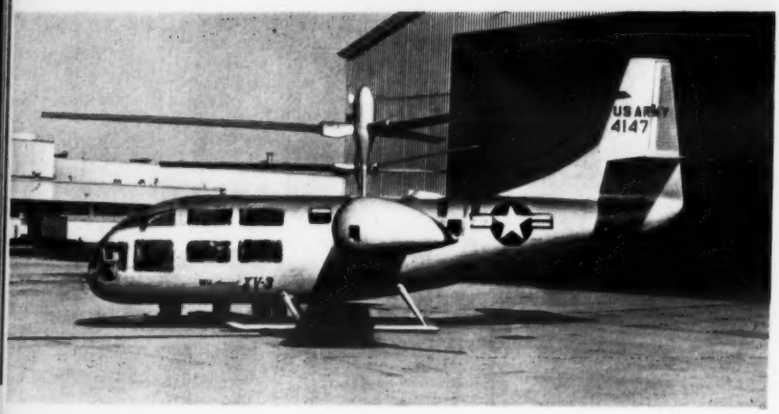
7

The pilot has chopped his power, the **Banshee's** wheels touch the deck as the tail hook engages an arrester cable well short of the emergency nylon barrier.

8

8

Slowed down by the arrester gear, the **Banshee** stops, the nylon crash net is lowered and the flight deck crew runs to direct the pilot as he taxies forward to the parking space.—Total time of the whole procedure, 16 seconds. But 16 seconds can be an awfully long time . . .



PROGRESS IN PICTURES

Bell XV-3 convertible aircraft

The Bell XV-3 single-engined convertible aircraft developed for the U.S. Army was demonstrated to a wider public for the first time at Fort Worth, Texas, early in February. It takes off and lands vertically like a helicopter. For level flight the two rotors mounted at the ends of a stub wing are tilted forward through 90° and take over the role of propellers. Two electric motors are fitted to tilt the rotors, the full process taking no more than 10 to 15 seconds.—The XV-3 is scheduled to make its first flight in April or May this year.

Bell Aircraft also plans to develop civil versions of this convertible aircraft: a five-seat touring aircraft to sell at about $75,000 and a larger version for 40 passengers to sell for $300,000 which could be ready about 1960.

One-man helicopter

The development of ultra-light one-man helicopters is continuing intensively in the United States, both for the Army and for the Navy. One of the firms involved, Rotor-Craft Corp., of Glenview, California, has been experimenting for some time with its rocket-powered RH-1 model, shown in the accompanying picture. The U.S. Navy is following the tests with interest. Power is supplied by two small rocket engines, built by Reaction Motors Inc., fitted in the rotor blade tips. Extremely simple structure keeps the empty weight down to 110 lbs.

VTOL - Vertical Take-Off and Landing

Unlike the Convair and Lockheed VTO aircraft, which take off and land on their tails, the experimental Bell model shown here carries out both operations in normal flying attitude. For this purpose the two Fairchild J-44 turbojets (1,000 lbs. s. t. each) are tilted downwards through 90° (as shown in picture). For level flight the two engines lie parallel to the aircraft's longitudinal axis. The aircraft is controlled during vertical take-off and landing by means of compressed air blown through nozzles in the tail and at the wing tips.

What's in the Air?*

AVIATION POLITICS

• America eases defence bids for foreign firms

Under the present liberalization programme for imports, Defense Secretary Charles E. Wilson has announced that foreign manufacturers will be given a greater opportunity to bid for U.S. Defense Department contracts. The armed services may now grant foreign firms contracts if their bids are at least 6% below the lowest U.S. offer.

• Reorganization of French Defence Ministry

A decree published in the "Journal Officiel" defines the competencies, both military and political, of General Koenig, the new Minister of National Defence, who is made responsible for liaison between the three armed services, while retaining all the competencies of the armed forces command (recruiting, training, control of equipment). Gaston Palewski, the Prime Minister's Delegate for Defence Questions, will take over a considerable part of those military responsibilities which hitherto, under the French Constitution, have fallen to the Prime Minister. In addition he will supervise the Institute for Higher Studies in National Defence, the Committee for Scientific Action and the High Commissariat for Atomic Energy, N.A.T.O. questions and those concerning the United Nations Disarmament Commission, the Industrial Zoning Organizational Committee and the Organizational Office for the African Colonies.

• Russian air engineer becomes Second Vice-Premier

The nomination of Lieutenant General Chrunichev as a Second Vice-Premier within the Supreme Soviet may be connected with Russian plans to speed up expansion of the Red Air Fleet. Despite his military rank, Chrunichev is not an armed services career man, but an air engineer. He will probably act as liaison between the "Managerial Group" and the Armed Services High Commands.

SERVICE AVIATION

• British guided weapons

Important releases on guided weapons in the United Kingdom are to be expected during the next few months, to offset recent Opposition criticism of alleged lack of progress.

• Theodore von Karman elected to Académie des Sciences

Professor Theodore von Karman, Chairman of N.A.T.O.'s Advisory Group for Aeronautical Research and Development, has been elected a member of the Académie des Sciences, the highest scientific distinction offered by France.

• General Bertrandias retires

Major General Victor E. Bertrandias, former Douglas Aircraft Co. Sales Vice-President, retired as Deputy Inspector General of the U.S. Air Force on February 25th and was presented with the Distinguished Service Medal. General Bertrandias is credited with nearly 37 years of service, begin ning in World War I when he was a member of Captain Eddie V. Rickenbacker's famous "Hat in the Ring" squadron.—New U.S.A.F. Deputy Inspector General is Major General Howard G. Bunker.

Canadian Minister of National Defence Ralph Campney has announced to Parliament that four R.C.A.F. squadrons stationed in Europe will be equipped with CF-100 *Canuck* all-weather jet fighters, of Avro Aircraft Ltd. (Canada), during 1955.

AIR TRANSPORTATION

• Airline subsidies cut

The U.S.Civil Aeronautics Board estimates that subsidy for fiscal 1954–55 and 1955–56 will be considerably less than its previous estimates for the two years. For 1955, figures are $66,151,000 instead of $79,426,000; for 1956, $61,698,000 instead of $79,100,000. The reductions are attributed to increases in trans-Pacific military mail and to the C.A.B.'s recent decision to cut P.A.A. and T.W.A. mail subsidies for the Atlantic.

• U.S. Army helicopters for commercial airlines?

The U.S. Army is considering lending some of its large helicopters to certain U.S. airlines, according to the "Wall Street Journal". The report claims that the helicopters would be loaned to a few feeder carriers operating between outlying areas and the cities served by major airlines. In return, the airlines would provide the necessary terminals and supply detailed reports on operations so that both manufacturers and the Army can benefit from their experience.—It is unofficially stated that five helicopter types are under consideration for the purpose, including three Sikorsky models (S-55, S-56 and S-58) and two Piaseckis (presumably the twin-rotor H-21 and ?). —So far five U.S. airlines are already using helicopters on regular commercial services: New York Airways (five Sikorsky S-55s); National Airlines (two S-55s); Los Angeles Airways (four S-55s); Helicopter Air Service of Chicago (six Bell 47Ds); and Mohawk Airlines (one S-55).

• Air France 1954 figures

Air France's report for 1954 reveals that the company carried 1,551,931 passengers during the year, an increase of 21% over the 1953 figure (1,319,762). Freight 43,652,414 kg (37,803,520 kg; + 15%); mail 11,084,400 kg (8,861,184 kg; + 25%).

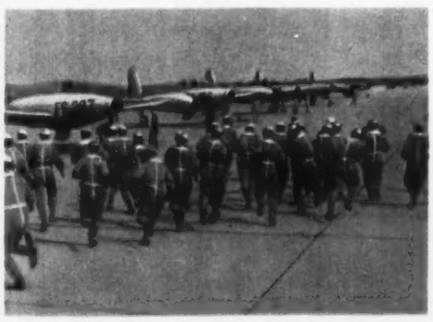
• K.L.M.'s 1954 figures and plans for 1955

In a press conference at The Hague, K.L.M. Royal Dutch Airlines President I. A. Aler and Deputy President F. von Balluseck disclosed that the number of capacity tonne-kilometres flown in 1954 totalled 346,000,000, an increase of 25% over 1953. Revenue tonne-km, however, advanced by only 16% to 207,000,000, so that K.L.M.'s average load factor barely touched 60%, compared with 64.5% in 1953.—Main contributing factor

The United Nations has issued two special stamps to commemorate the tenth anniversary of the International Civil Aviation Organization.

* Extracts from *Interavia Air Letter*, daily international news digest, in English, French and German. All rights reserved.

U.S. aircraft for Chinese Nationalist Air Force: (Left) Chinese fighter pilots running towards their Republic F-84G *Thunderjets;* (centre) a Chinese squadron of North American F-86 *Sabres* at Taipeh air base (Formosa); (right) Chinese pilots attending a lecture.



Helicopters in the Alps: (left) a SO. 1221 *Djinn* jet helicopter built by the French firm of S.N.C.A. du Sud-Ouest landed on the Jungfraujoch (11,620 ft.) on March 3rd, 1955. — (Right) A Bell 47 helicopter operated by Schweizerische Helicopter AG picking up a 440-lb. oil drum from a landing ramp, for carriage to the Gotthard Hospice (6,930 ft.).

to the expanded absolute passenger figure was the extension of tourist-class services (the whole of the passenger increase on the Amsterdam–New York route, for example, was due to tourist-class bookings). The increase in tonne-km offered is accounted for by the placing in service of new larger aircraft (Lockheed *Super Constellations*, Convair Liner 340s).—President Aler also announced that K.L.M. will take all possible measures during the coming year to improve load factor: increases in frequencies on the main routes (for example there will be a thrice-daily service between Amsterdam and New York, ten—instead of five—weekly freight services between Amsterdam and London, etc.); shortening of travel time through better connections, fewer intermediate landings, shorter waiting times on the ground; route agreements with other airlines (hitherto with 145), so that K.L.M. passengers will be able to book through tickets to 800 destinations in 140 countries. Finally, the availability of more reliable engines should help schedules to be flown more punctually.

● Fourth British airline-shipping merger

More than half the share capital in the British private airline Skyways Ltd. has been acquired by the shipping firm of Bibby Line Ltd. At the same time the capital has been increased from £157,000 to £315,000. A later rise to £1,000,000 is planned. Skyways' fleet at present comprises six Handley Page *Hermes*, 20 Avro *Yorks* and a number of Douglas DC-3s.—This is the fourth airline-shipping merger in Britain. It was preceded by Hunting Group with Clan Line Steamers Ltd. (October 1953), Airwork Ltd. with Furness Withy & Co. (February 1954), Britavia Ltd. (Silver City Airways and Aquila Airways) with General Steam Navigation Co.

Hostesses of Japan Air Lines undergoing training for duty aboard the Douglas DC-6 B.

INDUSTRY

● "Super Mystère" reaches supersonic speed

The day after its first flight (March 2nd, at Melun-Villaroche Flight Test Centre) the Dassault *Super Mystère XX*, piloted by Major Jean Boudier, already reached supersonic speed in level flight. It is thus the first Continental European aircraft to attain this performance.—The production version of the *Super Mystère XX* is to have a French SNECMA *Atar* engine, instead of the British *Avon*.

● New $ 460,000,000 order for Boeing Stratotanker

The U.S. Air Force has placed an additional order for $460,000,000 worth of Boeing KC-135 (707) *Stratotankers*, U.S. Air Force Secretary Harold E. Talbott announces. The first order, placed in the summer of 1954, is said to have been for a value of roughly $240,000,000, so that the total order for the *Stratotanker* is now estimated at $700,000,000.

FLYING EQUIPMENT

● The French S.N.C.A. du Sud-Est has developed a turbine version of its SE *Alouette I* single-rotor helicopter, designated the *SE. 3130 Alouette II*. A pre-production batch of five is already under construction, and a quantity order from the French Navy is under discussion. The SE. 3130 has an enclosed cabin for 4 to 5 persons. Gross weight is 2,980 to 3,300 lbs. Power plant is a Turboméca *Artouste II* turbine of 360 h.p. max. power.

● The *Nord 1750 Norelfe*, a helicopter fitted with a Turboméca *Artouste I* 280 h.p. turbine, has completed a 30-hour test phase at Les Mureaux (first flight on December 28th, 1954). The Nord 1750 was designed by the French engineer Jean Cantinieau and is under construction under the designation AC-13, at the Spanish firm of Aerotecnica, under whose licence S.N.C.A.N. has built its model.—Applications: observation, touring and sports, taxi services, ambulance and agricultural duties.

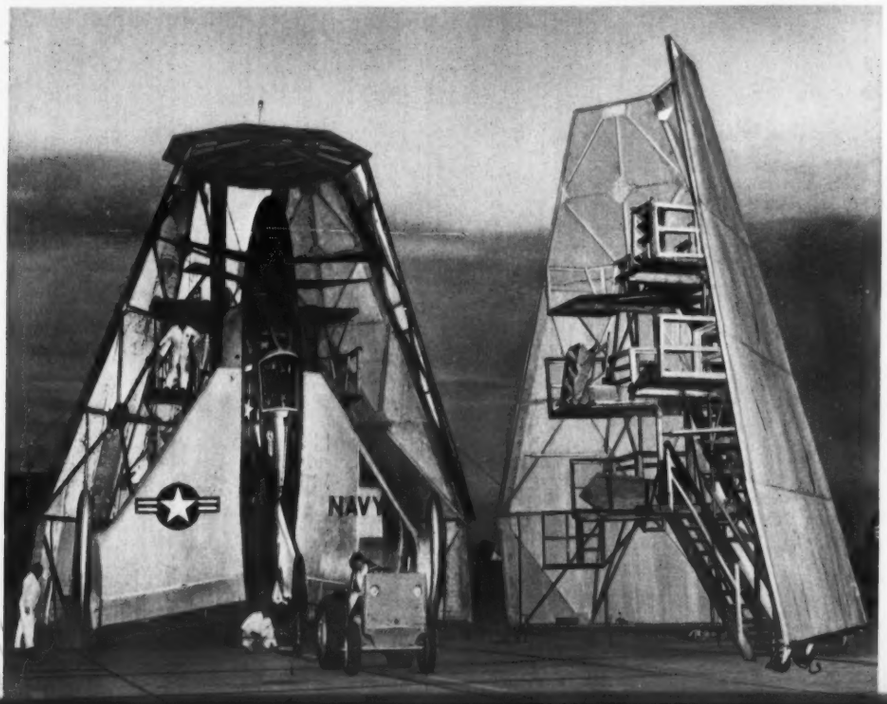
● The *SOBEH H-2* experimental helicopter, with ramjet power, built by the Dutch Institute for the Development and Construction of an Experimental Helicopter, is shortly to begin flight testing.—Data: take-off weight 1,320 lbs.; weight empty 550 lbs., max. speed more than 68 m.p.h., cruising speed 55 m.p.h., max. rate of climb in level flight 790 ft/min.—Rotor diameter 29 ft. 11¾ ins.

● A *Douglas F4D Skyray* Navy fighter climbed to 10,000 ft. in 56 seconds on February 19th, thus beating the record set up on February 12th by a McDonnell F3H-1N *Demon* by 15 seconds. The pilot, Douglas Test Pilot Robert O. Rahn, also holds the offical world speed record over 100 km, which he set up in a F4D on October 16th, 1953, at 1171.788 km/h.

● A *Boeing B-47 Stratojet* six-jet bomber has reached an average speed of 641 m.p.h. during a training flight covering 2,090 miles.

● Flight testing of *Ryan Aeronautical Co.'s V.T.O. experimental aircraft*, fitted with *Avon* turbojet, is scheduled to begin before the summer.

Special hangar designed for maintenance of the Convair XFY-1 *Pogo* vertical take-off aircraft. Standing roughly 36 ft. high, the hangar has a triple-deck work platform, consists of a wood and steel tube framework with fire-resistant yellow plastic covering.



The Next Generations of Long Range Aircraft

FROM A PAPER BY SIR ARNOLD HALL, DIRECTOR, ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH [1]

High Subsonic Speed Aircraft

During the last ten years, research has greatly increased our knowledge of the aerodynamic problems encountered near the speed of sound, and has brought the gas turbine engine to a high state of development. As a result, long range civil aircraft capable of cruising at high subsonic speeds—500 to 600 m.p.h.—can now be designed and such machines are likely to form the generation of long range aircraft which will follow the machines now about to come into service.

It is to answer the question " Why faster ?" that I propose to outline briefly what can be done in the light of the knowledge recently acquired, and to show that the answer is " A better service at a lower price ". I want, too, to make a claim that some part of the very substantial gain in economy of operation, as compared with present day long range aircraft, which will be obtained from high subsonic aircraft, should be devoted to features which will enhance reliability and safety.

*

High subsonic speed aircraft can be powered with turboprop or turbojet engines, and the wings can take several forms typified by the straight wing—for speeds up to 500 m.p.h.—and the swept-back wing of about 40° sweep angle (leading edge), or the delta wing of 45-50° sweep angle (leading edge)—for speeds up to 600 m.p.h. The operating height of this class of aircraft will be in the 35,000-45,000 feet altitude band, the turboprop types flying at rather lower levels than the turbojet.

The economic characteristics of such aircraft differ substantially from those of present long range types and, in particular, their operating costs can be considerably lower. Characteristics are, of course, to some extent influenced by the choice of wing plan form and propulsion system, but the economic variation between the arrangements is small compared with the change from present day standards. Apart from remarking that I believe that the turbojet type can be designed for comparably cheap operation at speeds substantially higher than the turbo-propeller type, I will leave the argument as to which layout and power plant is to be proclaimed the best to the protagonists of particular arrangements, and attempt to bring out the general characteristics of the class.

*

As compared with a direct operating cost of about 35 pence per capacity long ton nautical mile for present day long range aircraft,[2] *high subsonic aircraft will show direct costs of about 18 pence, and will, in addition, be capable of operating over considerably greater stage lengths.* Assuming the present level of indirect costs, the total cost (direct plus indirect) of high subsonic aircraft will be about *38 pence*, as compared with the present day *57 pence*, per capacity long ton nautical mile.

Table 1 : Cost in pence per capacity long ton nautical mile

1d = $0.0117	Typical present day long range aircraft with piston engines (Payload: 15,000 lbs.; 50 passengers)	Typical high subsonic speed aircraft (Payload 35,000 lbs. ; 120 passengers)
"Formula" direct operating cost	24.5d	11d
"In practice" addition to "formula cost"	10.5d	7d
Indirect cost	22d	20d*
Total cost	57d	38d

* Assuming present level of overheads.

In this table the " formula direct operating cost " means the direct cost, including the element for annual charges on the aircraft, according to an established costing formula (" The Standard Method for the Estimation of Direct Operation Costs of Aircraft " evolved by the Society of British Aircraft Constructors). *Table 2* shows the " make-up " of the formula cost in typical cases.

Fig. 1 : Formula direct operating costs for a swept-wing turbojet aircraft (cruising speed 478 knots = 550 m.p.h.) plotted against payload (in long tons), for various approach speeds (in knots) and corresponding take-off weights (in lbs.).

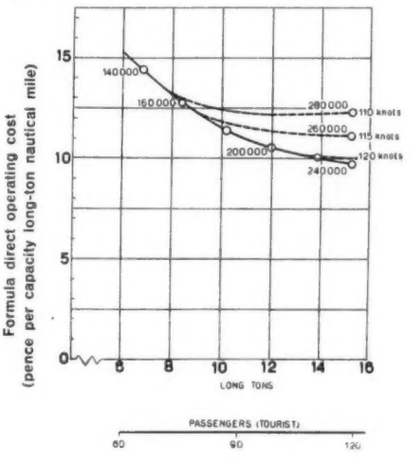


Table 2 : Analysis of First Costs and Direct Operating Costs

£1 = $2.80	Typical present day long range aircraft with piston engines (Payload: 15,000 lbs.; 50 passengers)	Typical high subsonic speed aircraft (Payload 35,000 lbs. ; 120 passengers)
Cruising speed	230 knots 265 m.p.h.	478 knots 550 m.p.h.
Route	London-Shannon-Gander-New York	London-New York direct
Stage speed (still air)	213 knots 245 m.p.h.	447 knots 510 m.p.h.
Take-off weight	145,000 lbs.	239,000 lbs.
First costs equipped airframe	£350,000	£800,000
First costs power plant	£80,000	£145,000
Direct operating costs per flying hour	£151	£286
In detail (per flying hour) :		
a) **Annual obsolescence**		
Equipped airframe and spares	£13	£29
Power plant and spares	£4	£9
Propeller and spares	£1	—
Insurance	£8	£17
b) **Maintenance and overhaul**		
Airframe and equipment	£25	£36
Power plant	£22	£67
Propellers	£5	—
c) **Flying**		
Cockpit crew	£12	£10
Fuel	£56	£109
Landing	£5	£9
Direct operating costs (pence) per long ton nautical mile in still air with 100% load factor	24d	10d
Direct operating costs (pence) per passenger nautical mile in still air with 100% load factor	2.4d	0.95d

Direct costs as they are found in practice differ from " formula costs " by an amount which depends on the route, and type of operation. In *table 1* a typical addition, as found in practice on a particular route, has been made for the present day aircraft, and an estimated " in practice " allowance as it might be found in a high subsonic aircraft operated in similar general circumstances has been added for that case.

For comparative purposes, it is convenient to work in terms of the " formula cost ", and this is done in what follows.

In *Fig. 1* are shown some of the economic characteristics of the high subsonic class, as typified by aircraft designed for the non-stop

[1] Brancker Memorial Lecture, read to the Institute of Transport on February 14th, 1955 ; extracts reproduced by permission of the author.

[2] The English long ton contains 2,240 lbs. and is roughly equivalent to the metric tonne. A penny equals roughly 1.17 cents.

London-New York flight, at 550 m.p.h. This is a stage length of 3,000 nautical miles ; the still air range, to provide normal allowances for wind and fuel reserves, is 4,800 nautical miles. The figure shows the formula direct operating cost, as a function of the payload and the landing approach speed for which the aircraft is designed. The take-off weight is indicated at particular points. (The landing approach speed quoted is the " speed over the hedge "; some prefer to quote the speed in the early stages of the approach, but the two are usually related in a simple way).

Examination of the influence of designed capacity payload *(Fig. 2)* shows that there is economic benefit to be derived from increasing the designed payload as compared with that carried by contemporary long range aircraft, if the traffic available, and frequency of service needed, will permit. For example, a 60 seat aircraft, used for 3,000 hours each year operates at a direct cost some 15% higher than a 90 seat aircraft used for 2,000 hours each year, though the passenger movements provided are the same. It is generally the case that the public expect a frequency of service roughly equal to the journey time, a fact which seems to apply to many forms of transport. This class of aircraft will more than halve the journey time compared with present standards, and lead to a demand for a correspondingly higher frequency of service. It will be of advantage to the operator to resist this pressure so far as the size of the market makes it necessary, and competition permits, in order to obtain the financial advantage of operating aircraft designed for relatively high payloads.

The influence of the range for which the aircraft is designed is indicated in *Fig. 2*, by the comparison of the lines for 2,000 and 3,000 nautical mile stage lengths e.g., London-Gander, compared with London-New York. The respective still air ranges, to provide normal allowances for wind and fuel reserves are 3,700 and 4,800 nautical miles. The increase in direct operating costs consequent on designing for the longer stage is about 5%—or less than 3% on total costs—a figure sufficiently low to make it probable that, on the North Atlantic route, operators will prefer the aircraft capable of the non-stop London-New York flight.

The economies in direct operating costs shown by the high subsonic class of aeroplane, compared with present day long range machines, arises mainly from their higher annual earning capacity, due to higher speed. The question " Why faster ? " has the answer " A better service at a lower cost." Where the traffic offered justifies it—and, by the time such aircraft are available, the North Atlantic route probably will—a further gain in economy is obtainable by operating larger aircraft, designed for a higher capacity payload.

Some part of the inherent economy should, I think, be given to features which will increase reliability and safety, rather than that the " last ounce " should be taken in cruising economy. I think that one of the most important of such features is the reduction of the landing approach speed of the aircraft. The cost of making a reduction can be judged from *Fig. 1* from which it is evident that only a small proportion of the saving which will be obtained need be foregone to allow an improvement on present standards (approx. 115 kn). The landing approach speed has a considerable influence on the ability of the aircraft to land safely in conditions of bad visibility. It is likely to prove " good business "—in terms of reduction of bad weather diversion, and accident rate—to design for lower approach speeds. When this is done, the long range airline operator will still have a machine capable of operating at a substantially lower direct operating cost than present equipment.

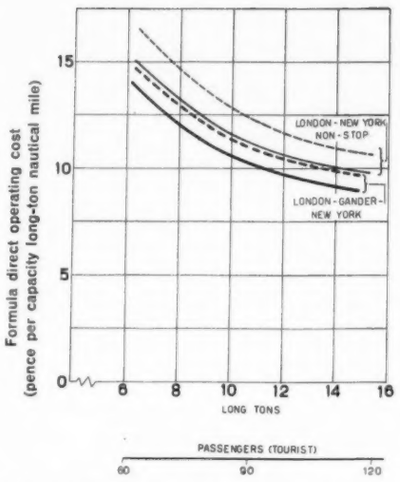


Fig. 2 : Formula direct operating costs for a swept-wing turbojet aircraft (cruising speed 478 knots) plotted against payload (in long tons) for various annual utilization figures and still air ranges : ——— 3,000 hours utilization per year ; – – – – – 2,000 hours per year. The thin (upper) curves are for non-stop flight from London to New York, the thick (lower) curves for London-Gander-New York.

The Supersonic Aircraft

In recent years, we have acquired some knowledge of supersonic aerodynamics and while there is still much to learn, present information is enough to permit an attempt to assess the likely performance of a supersonic civil aeroplane. In doing this it should be borne in mind that we will acquire much more knowledge in this field in coming years, and it is therefore probable that, in time, we will be able to do much better than now seems possible. In mentioning the supersonic position as it now appears, I do not wish to suggest that we will contemplate building such an aircraft in the near future. All I seek to do is to clothe a not infrequent topic of general conversation with some reality.

As usual, there are a number of geometrical layouts which can be contemplated, and which have their advantages and defects. But, taking as a starting point a design, shown in *Fig. 3*, which has characteristics which would enable it to take-off and land on main-terminal runways, I think we will not be severely misled on the operating economics as they can now be contemplated. The figures of *Table 3* emerge for aircraft cruising at 1,300 m.p.h. (Mach No. 2). No. 1 aircraft is suitable for medium stage lengths ; it could, for example, make the journey from London to New York, with a stop at Gander, in about 4 hours, carrying 50 passengers. No. 2 could fly from London to New York non stop, in 2¾ hours, carrying 20 passengers. These aircraft would cruise at altitudes between 45,000 and 55,000 feet.

Fig. 3 : Possible lay-out for a long-range twin-jet supersonic commercial aircraft, which could take off and land at existing large airports.

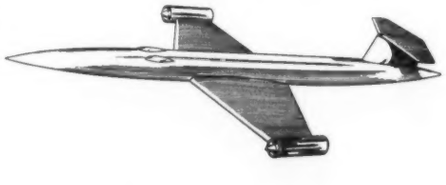


Table 3 : Direct operating costs for two supersonic aircraft, in pence per capacity long ton nautical mile

Aircraft type	No. 1	No. 2
Stage length (with fuel reserves)	2,000 (e.g.London-Gander)	3,000 n.m. (e.g. London-New York)
Flight time	2 hours	2 ¾ hours
Number of passengers	50	20
Take-off weight	270,000 lbs.	320,000 lbs.
" Formula " direct operating cost	35d	110d
Total operating cost	70d	175d

The ratio of total cost for No. 1 aircraft to present day long range aircraft is approx. 1.2, for No. 2 aircraft approx. 3.

Having in mind that when the time comes we will certainly be able to do better than these figures suggest, and noting that, for the medium length stage at least, the cost emerging on the basis of present knowledge, being about 20% higher than present costs, is not outrageously high, it seems to me likely that the development of long range supersonic civil aviation will follow the exploitation of the high subsonic possibilities. The influence of the higher annual earning capacity which increase of speed represents is a potent one, and whilst, on present knowledge, it is offset in the overall economic picture by lower aerodynamic efficiencies in supersonic, as compared with subsonic, conditions, only small changes in the aerodynamic position are needed to allow it to reassert its dominance. I will be surprised if, in a few years' time, we will not be able to see the economics of the No. 1 aeroplane in machines capable of the non-stop London-New York flight.

A time-table looking something like *Table 4* is not without its attractions. The curious, and perhaps convenient, results of flying " faster than the sun " are evident.

Table 4 : Time-table for a trans-Atlantic supersonic service
(all times are local times)

New York	London	New York	London	New York
D 24.00	A 08.00			
	D 11.00	A 09.00		
		D 12.00	A 20.00	
			D 23.00	A 21.00
				D 24.00

Conclusion

Many of the possibilities before us are exciting—aviation will continue to move fast. The engineer is sometimes accused—sometimes rightly, sometimes wrongly—of wanting the new when the consolidation of the old would be wiser. The civil aviation scene needs some of both. In the long range field at least we need new breeds of aircraft to provide the economy and service the passenger needs, and the possibilities are before us, but we must eliminate the not entirely incorrect idea that aviation still has some hazards. This is the major matter to be borne in mind when capitalising the newer possibilities. It is to this that attention must be continuously directed, and if we have an eye on the distant possibilities—as it is right that we should—we should nevertheless see to it that the fullest use is made at the earliest opportunity of those things which make for a safe, reliable journey at a reasonable price.

AFTER THE RATIFICATION BY THE GERMAN PARLIAMENT

With the West German Parliament's ratification of the Paris Agreements by a large majority, the curtain went up on German aviation on February 27th, 1955, revealing the stage to be still empty.

Deutsche Lufthansa began proving flights inside Germany on March 1st, and has been authorized to open regular domestic services with four Convair 340s and three Douglas DC-3s on April 1st, to extend these services into a European network from May 15th and finally to open a Hamburg-New York route with Lockheed *Super Constellations*—of the eight on order four are to be delivered this year—on June 1st. Nine B.E.A. pilots have been engaged as captains for the European network, and ten Americans for the overseas network.

A memorandum submitted to the Bonn Parliament by Deutsche Lufthansa, which " nobody " is said to have seen previously, gives the amount of capital needed for the 1955 business year as DM 136,000,000, compared with the earlier estimate of DM 85,000,000.

The Lufthansa management hopes to make the airline self-supporting by 1958, which should please the Federal Finance Minister. Commercial Director Hans M. Bongers has apparently calculated that the passenger, mail and freight volume on overseas routes to North and South America and the Far East should enable him financially to balance a perhaps deliberately restricted short and medium-stage network in Europe. As relations with the United States, some of the South American countries, and the Near and Far East are flourishing, thanks to the general economic upsurge in Germany, Bongers' calculations may work out. There will be no lack of passengers or of freight, by 1958 the Germans crews will have learned quite a lot, and the " Fräuleins " will be able to provide first-class meals on board, with Munich beer and Frankfurters.

However, critical voices have already been raised in Germany. For example, Kurt W. Streit writing in the Hamburg weekly " Die Zeit " early in March, found cause for concern in the Lufthansa's financial structure. The Lufthansa is under-capitalized, he says, with too high a proportion of Government funds ; private capital is going into rival charter companies, and both the official aviation administration and Lufthansa's organization have been so over-staffed in the last few years that desk work has become more important than flying.

Other critics express the view that the resumption of air services is an experiment whose result will depend on the capability of the company's management and on its capital foundation. At the beginning of 1953 Lufthansa already employed about 200 persons in its offices and had since been planning and replanning—without flight personnel. By 1958 it will become clear whether the present final calculations are correct. Originally Lufthansa planned for self-sufficiency with a fleet of at least 20 units, ten each for medium and long-range operations. Now it hopes to be able to pay its way with 12 modern aircraft. This relatively small fleet does not appear too promising, as it is difficult for any airline to cover operating costs with so few aircraft. How Lufthansa proposes to serve, on its Atlantic flights, the large number of West German cities which could provide worthwhile traffic, appears somewhat enigmatic.

But it is too early to regard the new airline with either pessimism or optimism. The onlooker can only wait and see what president, board and management make out of the instrument they have been given.

*

So much for air transport planning. What progress is being made in *the organization of the air forces* ?

One point in the programme has already been fixed : in the second week in May the much-discussed Blank Office, or its Coblenz branch, is organizing a demonstration of the trainers from which the final selection will be made, at an R.A.F. base near Cologne or—if the British authorities do not agree to this arrangement—at the Fokker plant at Amsterdam-Schiphol. There are seven " candidates " on the list : the Piaggio P. 148, Saab 91 *Safir*, Beech T-34 *Mentor*, Temco (T-35 ?), de Havilland (Canada) *Chipmunk*, Fokker S. 11 and Morane-Saulnier (MS. 733 ?).

According to German sources, three basic types will be chosen for flying training, and it is hoped, for economy reasons, to be able to keep to the same three types for some time and even to produce them under licence. The three categories are : light to medium trainer with piston engine, for elementary training ; medium to heavy jet trainer for advanced training ; and dual control combat aircraft for combat training. — Training is the most important aspect of all equipment and personnel planning.[1]

Meanwhile it seems to be certain that the U.S. Air Force will bear the lion's share in training, from the point of view of both equipment and personnel. A number of American bases in South Germany, complete with full equipment and instructors, are to be placed at the disposal of the future German air forces and gradually taken over entirely by the latter, who would thus get a considerable number of Pipers—for elementary training—and of Lockheed T-33 jet trainers. The U.S. Air Force is also said to have offered to train another 400 German pilots in the United States.

There is no doubt that things are beginning to move. Lieutenant General Wolfgang Vorwald, who is more or less responsible for the choice of equipment, paid a visit to Britain in February 1955, and paid special attention to electronic firms. Arms Representative Blank is to follow his example, replying to a cordial invitation from the Ministry of Supply. These first foreign contacts will scarcely remain the only ones.

[1] Cf. also *Interavia* No. 3, 1955 : " The West-East No-Man's-Land in Europe ", and *Interavia* No. 11, 1954 : " Germany Re-Enters the Arena."

One of Deutsche Lufthansa's Convair Liner 340s.

The first of the four Lockheed L-1049 Super Constellations *in final assembly for Lufthansa.*

Equipment Round-Up

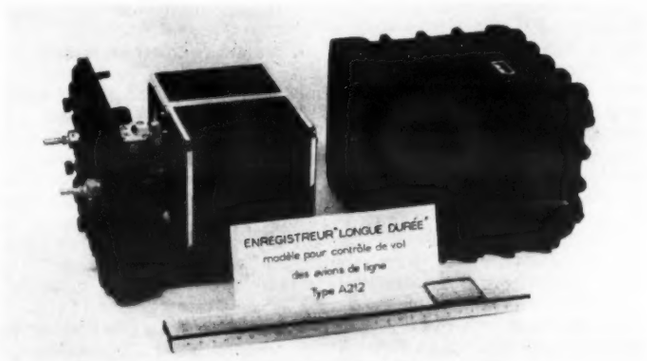
● **A portable compressor** for starting jet engines of the 10,000 lbs. thrust class has been developed for the U.S. Air Force by *Solar Aircraft Company*, of San Diego. The unit can also be used to supply electric and hydraulic power for checking airborne equipment before the engines are started. Power is supplied by a 500 h.p. Solar *Jupiter* gas turbine, whose centrifugal compressor provides the compressed air required for starting.

● **Recording Equipment for Flight Testing**

Société de Fabrication d'Instruments de Mesure (S.F.I.M.), Paris, are the manufacturers of light recording equipment for flight test values, which is already in use by a number of European aircraft manufacturers in the testing of new aircraft.

Simultaneous recording can be made, on a strip of photographic paper, of up to nine parameters, six continuous and three discontinuous. Each recorder incorporates a time base with a precision of 1‰, which makes a timing mark every second. The latter is omitted every tenth second to facilitate counting.

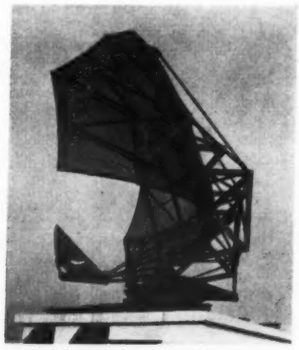
Parameters are recorded photographically by means of moving mirror elements with a high natural frequency and corresponding high rate of response, which direct a concentrated light beam in accordance with the variations in the measuring values. Since the recordings may cross one another, the whole width of the paper can be used for each parameter (full scale deflection of 50 mm). Reading accuracy is better than 0.2 mm, or 0.4%. Two types of measuring



elements are available, those mounted in the recorder for direct measurements, and those mounted elsewhere and transmitting their values to an element in the recorder.

● **50-cm airport radar**

The S.232, first completely crystal-controlled multi-purpose radar, made by *Marconi's Wireless Telegraph Co. Ltd.*, is shortly to be installed at London Airport. Pictures show an experimental version recently tested. —Compared with other modern radar installations, most of which work in the 3-cm or 10-cm band, the new Marconi version is designed for much lower frequencies (500-610 mc/s), i.e. the 50-cm band. This, the makers claim, greatly reduces sensitivity to rain and cloud disturbances. Another feature is the Moving Target Indicator, which eliminates permanent echoes from fixed obstructions, such as mountains, tall buildings etc. Thanks to this system, aircraft can be detected at ranges of ¾ of a mile to 100 miles. The aerial system can be set for continuous rotation (from ½ to 10 r.p.m.) or for sweeping an arc of from 10° to 60° on either side of a selected beam (up to 2½ r.p.m.). The radar can thus be used for either long range surveillance or close control of landing approach. Up to eight screens can be connected to each aerial group.—The use of crystal stabilization ensures that the installation is at all times ready for use, without previous tuning. *Technical data :* peak power output 50-60 kW; pulse length 2 or 4 microseconds (remote controlled from operating desk); receiver intermediate frequency 45 mc/s; power requirement 400 Volt 3-phase 50-cycle, approx. 12 kVA ; aerial dimensions 29 × 10 ft.



● Periscopic sextant with automatic integration

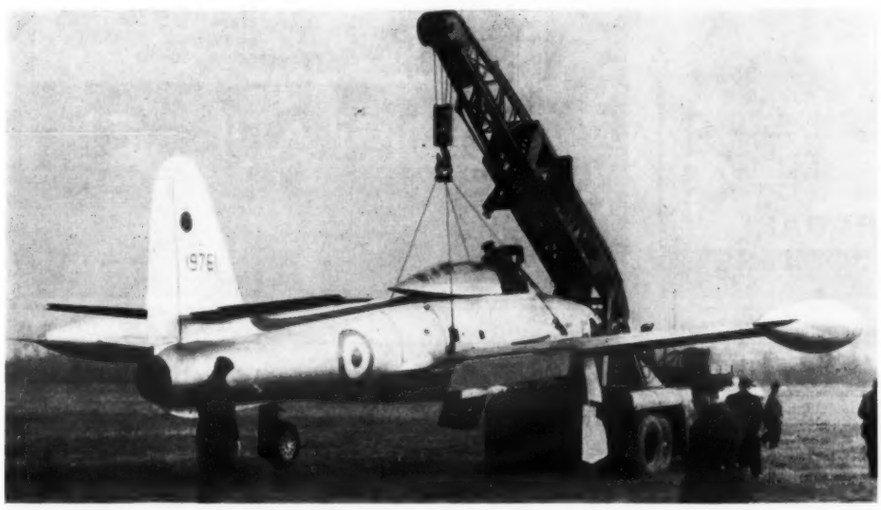
Kelvin & Hughes (Aviation) Limited, of Barkingside, England, has developed a periscopic sextant specially designed for installation in pressure cabins. A valuable aid in celestial air navigation, the sextant can be used to measure both altitude and azimuth of a celestial body, and also replaces the astro compass.

The sextant, rotatable about the periscopic tube, is fitted in a mounting attached to the inside of the pressure cabin. The mounting carries a pressure-tight tube, which encloses the periscopic tube and serves as a guide when moving the sextant in or out. The guide tube is electrically heated, to prevent the sextant from freezing in its mounting at low outside temperatures.

The altitude of a heavenly body is measured by means of an index prism in the periscopic head, which can be roughly set before the measuring process in steps of 10°. Fine setting of the optical sighting beam, within a range of 14°, is done by means of an electric motor. The altitude can be observed for any desired period of time up to 2 minutes, and the mean value obtained by an electrically driven automatic cone and cylinder integrator.

The periscopic tube also carries an azimuth scale, read with the aid of an index on the edge of the periscopic mounting and indicating the azimuth of the observed celestial body —apparently in relation to the aircraft's longitudinal axis. By making allowance for the appropriate true course, the true azimuth of the heavenly body can be determined.

Magnification is four-fold and field of view 8 degrees. The equipment can be used in all lighting conditions (day and night) with the aid of filters and adjustable illumination (setting knobs on the oblique cylinders on either side of the sextant housing). A bubble in the field of sight of the eyepiece serves as reference for the horizontal plane. To prevent ice formation and condensation, the window of the periscopic head is electrically heated. Current required for the electric motors, heating system and lighting is 24 V D.C. The periscopic sextant weighs only 7 lbs. and the mounting 5 lbs.



● Mobile conveyor and salvage cranes

for loads of 3 to 25 tons are made in several versions by *Belotti, Genoa.*—Picture shows the *B.52A* heavy crane lifting a Republic F-84 *Thunderjet* fighter. This crane is built for a maximum load of 25 tons and is particularly suited for use at civil and military airfields. The jib, of robust grid construction, is mounted on a three-axle chassis and can be extended to a length of 23 ft. by means of a hydraulic jack. With the jib horizontal and extended to 16.5 ft, loads of up to 10 tons can be carried. Jib length for lifting the maximum permissible load of 25 tons is roughly 3 ft. The chassis is driven by a 90 h.p. Fiat Type 642 diesel engine, which gives the vehicle a speed of 25 m.p.h. on the road. Dimensions : length of vehicle 23 ft., width 9 ft. ; overall height with jib horizontal 12 ft.

The Belotti range of cranes also includes the *B.51* for a load of 7 tons and the 12-ton *B.52*, similar to the vehicle described above, with four driving wheels and three guide wheels, telescopic jib.

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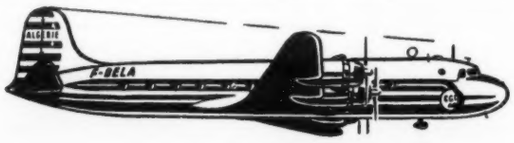

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LIST OF ADVERTISERS IN INTERAVIA No. 4, 1955

	Page
Aigle Azur, Paris	274
Air Algérie, Paris	272
Air France, Paris	229
Alitalia, Rome	228
Boet, A., & Cie., Ascq	274
Bréguet, L., Avions, Paris	226
British Petroleum Co. Ltd., London	218
Canadair Ltd., Montreal	216
Canadian International Trade Fair, Toronto	228
Collins Radio Co., Cedar Rapids, Iowa	217
Contraves Italiana S.p.A., Rome	227
Construzioni Aeronautiche Giovanni Agusta, Cascina Costa-Gallarate	272
Decca Navigator Co., London	220
Douglas Aircraft Co. Inc., Santa Monica	221
English Electric Co. Ltd., London	234
Fairchild Engine & Airplane Co., Hagerstown	219
Fenwick "Titeflex", Paris	273
Fiat S.p.Az., Turin	210
Fire Armour Ltd., London	228
Fokker, N.V. Koninklijke Nederlandse Vliegtuigenfabriek, Amsterdam	212
Gilfillan Bros., Los Angeles, Calif.	275
Hispano-Suiza, Bois-Colombes	224
Iberia, Líneas Aéreas Españolas, Madrid	273
Linee Aeree Italiane, Rome	273
Messier, Paris	213
Motokov S.A., Prague	224
New York Air Brake Co., New York	276
O.F.E.M.A., Paris	226
Officine di Pomigliano per Costruzioni Aeronautiche e Ferroviarie (AERFER), Naples	274
Paris Airport	222
Pioneer Parachute Co., Manchester, Conn.	274
Potez, Société des Moteurs, Paris	272
Pye Telecommunications Ltd., Cambridge	233
Sabena, Brussels	211
SNCA du Nord, Paris	231
SNCA du Sud-Est, Paris	232
SNCA du Sud-Ouest, Paris	225
Société de Fabrication d'Instruments de Mesure SFIM, Paris	274
Souriau, P., & Co., Billancourt	272
Strüver, Ad., G.m.b.H., Hamburg	273
Thomson-Houston, Compagnie Française, Paris	223
United Aircraft Export Corp., East Hartford, Conn.	214-215

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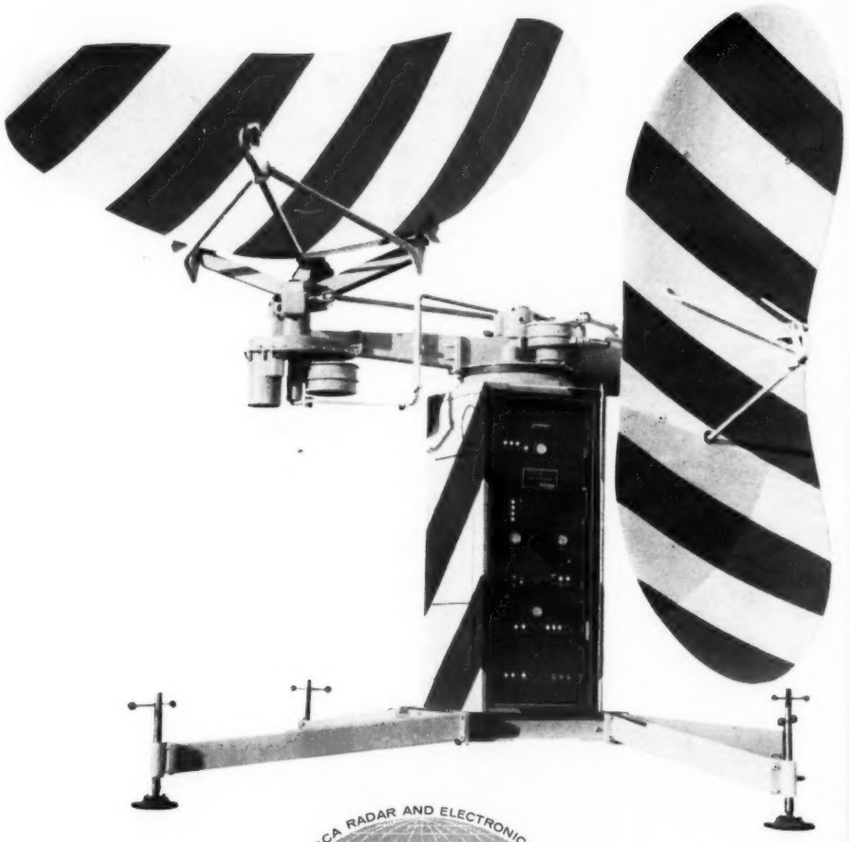

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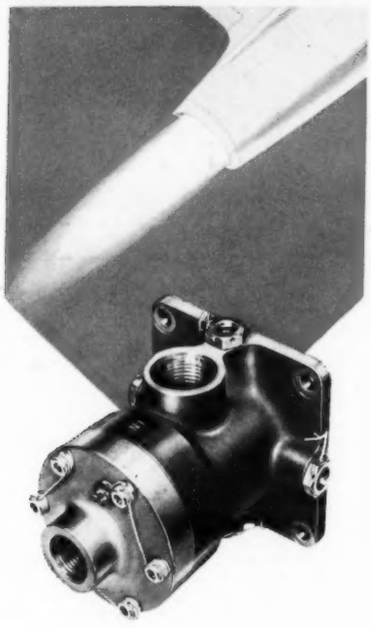

FOR HIGHER CEILINGS

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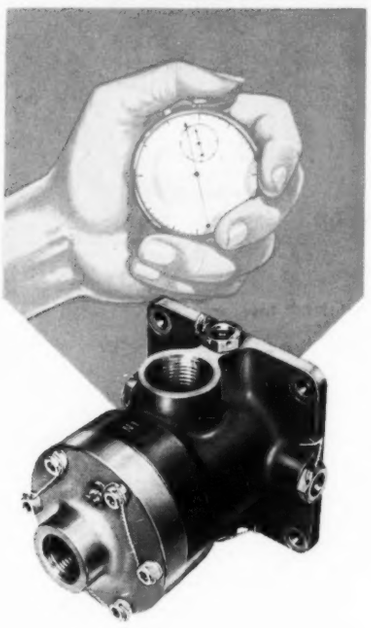

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